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A Review of the Genera of Pectinariidae (Polychaeta) Together with a Description of the Australian Fauna

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ABSTRACT. The polychaete worm family Pectinariidae is represented in Australian waters by five species (*Amphictene favona* n.sp., *A. uniloba* n.sp., *Pectinaria antipoda* Schmarda, 1861, *P. dodeka* n.sp. and *P. kanabinos* n.sp.). *Pectinaria antipoda* is redescribed and a neotype designated. Generic diagnoses are given for all genera including three not known from Australian waters. Additional characters are described for each genus that may facilitate the separation of species. A key to all genera and to species present in Australia is given, as are tables summarising the characters of all described species.

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The family Pectinariidae is poorly known from Australian waters even though it is an easily recognised family with its characteristic "ice-cream cone"-shaped sandy tube. Day & Hutchings (1979) recorded three species in three genera from Australia. Fauchald (1977) recognised five genera worldwide, and elevated several previously recognised subgenera to full generic status, and has been followed in this study. Hartman (1941) recognised five genera or subgenera and provided a key to genera, but little discussion of them. She suggested that *Amphictene*, *Pectinaria* and *Cistenides* are more closely related to each other than to the other two genera, *Lagis* and *Petta*, but does not qualify this statement. Holthe (1986) in his study of the family did not follow Fauchald (1977) and only recognised two genera, *Pectinaria* and *Petta*, and four subgenera within *Pectinaria*, although he does not provide a key to subgenera and stated that "specific characters serve better than the subgeneric ones for the purposes of identification". He provides no reasons for accepting these as subgenera rather than as separate genera, other than it is a matter of opinion. Similarly, Day (1967) used the concept of the subgenera with no justification. Other studies on pectinariids by Long (1973) and Wolf (1984) have not accepted these subgenera. We have therefore provided a diagnosis for each genus together with a table providing the diagnostic characters for each species currently assigned to that genus, as well as a table listing the major characters distinguishing the genera.

The family name Pectinariidae Quatrefages, 1865 is used here following the ruling by the International Commission on Zoological Nomenclature (Opinion 1225, 1982) that the name Amphictenidae Grube, 1851 did not have priority over the name Pectinariidae based on common usage.

Although pectinariids are not abundant in benthic samples collected in Australian waters, they are regularly collected but are not easily identified to species as no keys are available. A comprehensive survey of the family was undertaken, examining material available in all Australian museum collections. Five species were distinguished, of which four are new. Two genera were represented. *Pectinaria antipoda* is redescribed and a neotype designated. At least one fossil species of *Pectinaria* has been recorded by Katto (1976), but only living species are included in the relevant table. A key to the world genera and Australian species is given. The distribution of each Australian species is illustrated, with an indication given as to its abundance.

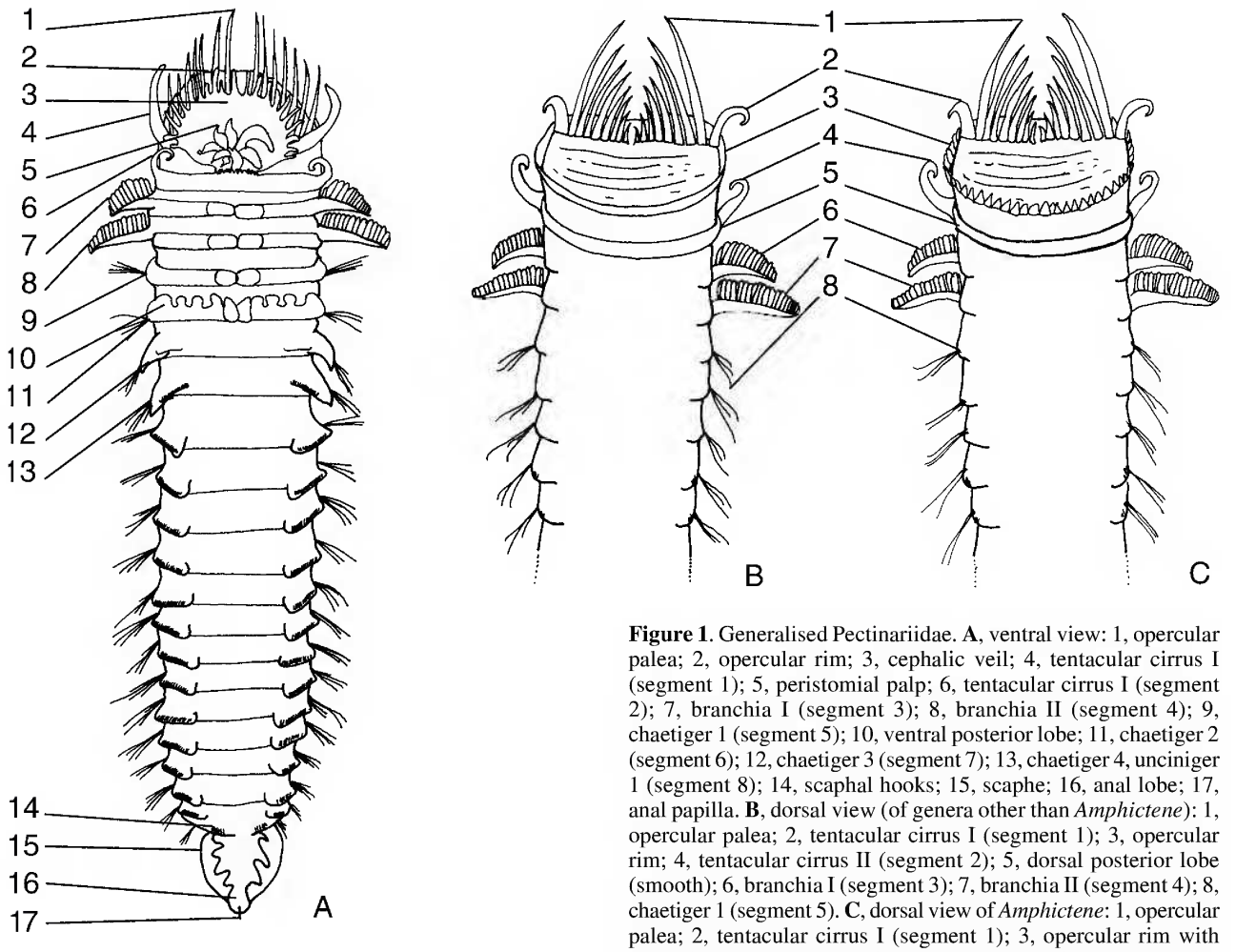

Figure 1. Generalised Pectinariidae. **A**, ventral view: 1, opercular palea; 2, opercular rim; 3, cephalic veil; 4, tentacular cirrus I (segment 1); 5, peristomial palp; 6, tentacular cirrus I (segment 2); 7, branchia I (segment 3); 8, branchia II (segment 4); 9, chaetiger 1 (segment 5); 10, ventral posterior lobe; 11, chaetiger 2 (segment 6); 12, chaetiger 3 (segment 7); 13, chaetiger 4, unciniger 1 (segment 8); 14, scaphal hooks; 15, scaphe; 16, anal lobe; 17, anal papilla. **B**, dorsal view (of genera other than *Amphictene*): 1, opercular palea; 2, tentacular cirrus I (segment 1); 3, opercular rim; 4, tentacular cirrus II (segment 2); 5, dorsal posterior lobe (smooth); 6, branchia I (segment 3); 7, branchia II (segment 4); 8, chaetiger 1 (segment 5). **C**, dorsal view of *Amphictene*: 1, opercular palea; 2, tentacular cirrus I (segment 1); 3, opercular rim with appendages; 4, tentacular cirrus I (segment 2); 5, dorsal posterior lobe; 6, branchia I (segment 3); 7, branchia II (segment 4); 8, chaetiger 1 (segment 5).

Methods

The following measurements were recorded for each animal: total length in mm, width of anterior segments and posterior segments. This information is given for type material and ranges given for the additional material examined. The width of anterior and posterior segments is given sequentially (e.g., 15 & 10 mm indicates that the specimen is 15 mm wide anteriorly and 10 mm posteriorly). Anterior width was measured at segment 3 and posterior width at the last chaetigerous segment. The presence or absence of coelomic gametes was noted, and in all cases sexually mature material was available for examination and indicated in the *material examined* sections with an "*". Notochaetae from chaetigers 4 and 14 and neurochaetae from chaetiger 8 were examined using SEM. Additional material examined for each species is listed by State in a west to east direction. In cases where a large amount of material was available, only a selection of the material examined is listed. All descriptions are based on the holotype unless stated, and the variation within paratypes or additional material examined is given in the variation section. The descriptions were generated using Delta to provide standardised species and generic descriptions (Dallwitz, 1980; Dallwitz *et al.*, 1993) and then edited. A schematic pectinariid (Fig. 1A–B) illustrating all the characters is given to facilitate the use of the key to the genera and species. In addition, the numbering of segments is given and the first segment on which noto- and neurochaetae occur. A key to all genera and Australian species is given, but does not imply any phylogenetic relationships.

The following abbreviations have been used in the text:

AM	Australian Museum, Sydney;
BMNH	The Natural History Museum, London;
HZM	Zoologisches Institut und Zoologisches Museum der Universität Hamburg;
LACM-AHF	Los Angeles County Museum, Los Angeles, formerly The Allan Hancock Foundation;
MV	Museum Victoria, Melbourne;
NTM	Museums and Art Galleries of the Northern Territory, Darwin;
QM	Queensland Museum, Brisbane;
SAM	South Australian Museum, Adelaide;
TMAG	Tasmanian Museum and Art Gallery, Hobart;
USNM	National Museum of Natural History, Washington, D.C.;
WAM	Western Australian Museum, Perth;
ZMB	Zoologisches Museum, Museum für Naturkunde der Humboldt-Universität, Berlin.

Taxonomy

The Pectinariidae form a clade with the Ampharetidae and Alvinellidae and belong to the Terebellida (Rouse & Fauchald, 1997). The characters defining the monophyly of the family include: cone-shaped tubes, the presence of a cephalic veil, and the development of a flattened scaphe with spine-like chaetae (Fauchald & Rouse, 1997).

Definition. Body divided into three sections thorax, abdomen and scaphe; thorax and abdomen of 22 segments of which 16–17 chaetigerous, and scaphe of 5 fused segments. Prostomium completely fused to peristomium and reduced. Peristomial palps (buccal antennae) grooved, present on or around the peristomial lips, and cannot be retracted into buccal cavity. Cephalic veil broad and thin, arising behind the peristomial palps. First segment completely fused to head, and expanded to form an opercular plate; the margins of which elevated to form the posterodorsal lobe (opercular rim), either smooth or cirrate. The opercular plate with two combs of notopodial paleae, often long and golden. Remaining notopodia with capillary notochaetae. Neuropodia with uncini having numerous subequal teeth arranged in one or more vertical rows. Scaphe with two combs of modified chaetae in the form of hooks. Two pairs of pectinate branchiae on segments 4 and 5.

Remarks. The tentacular cirri present on segments 2 and 3 have an unknown relationship to any other kind of cirri reported. Fauchald & Rouse (1997) suggest these tentacular cirri are not homologous to those found in other families, and may represent structures unique to the pectinariids.

While the terms abdomen and thorax are widely used within the family, the concept differs from that found in the closely related ampharetids. We have referred to the thorax as including the anterior achaetigerous segments and the initial chaetigerous segments with only notopodia. The term abdomen refers to all the following chaetigerous segments with both noto- and neuropodia as well as well as the last chaetigerous segment with notopodia. In contrast in the ampharetids, the thorax refers to all chaetigerous segments with both noto- and neuropodia and the abdomen to the posterior segments with only neuropodia.

The above definition is based on Rouse & Fauchald (1997) although we have expanded it.

Key to genera and Australian species of Pectinariidae

Genera not recorded from Australian waters are identified by the asterisk.

1 Cephalic veil cirrate. Scaphe distinctly separated from abdomen 2

—— Cephalic veil smooth. Scaphe indistinctly separated from abdomen ..... *Petta**

2 Dorsal opercular rim smooth 3

—— Dorsal opercular rim cirrate ..... (*Amphictene*) 5

3 Cephalic veil free. 13 biramous chaetigers 4

—— Cephalic veil laterally attached. 12 biramous chaetigers ..... *Lagis**

4 Major teeth of uncini in 1 row ..... *Cistenides**

—— Major teeth of uncini in 2 rows ..... (*Pectinaria*) 6

5 First tentacular cirri arise from anterior margin of segment 2; posterodorsal lobe absent ..... *Amphictene uniloba* n.sp.

—— First tentacular cirri arise from posterior margin of segment 2; posterodorsal lobe present ..... *Amphictene favona* n.sp.

5 Anteroventral lobe of chaetiger 2 slightly incised forming glandular lobes (Fig. 14A) 7

—— Anteroventral lobe of chaetiger 2 with contiguous large rounded papillae, 12–19 present (Fig. 9A) ..... *Pectinaria antipoda*

7 Paleae subacute with compact tips (Fig. 14A); cephalic veil with 16–28 cirri ..... *Pectinaria dodeka* n.sp.

—— Paleae acute with extended tips (Fig. 16A); cephalic veil with 10–16 cirri ..... *Pectinaria kanabinos* n.sp.

Amphictene Lamarck, 1818

Amphictene Lamarck, 1818: 89.–Fauchald, 1977: 120.
Pectinaria (Amphictene).–Holthe, 1986: 22.

Diagnosis. Rim of cephalic veil with numerous long cirri. Cephalic veil completely free from operculum forming dorsal semi-circle around numerous peristomial palps. Raised opercular margin cirrate. Chaetigers 1 to 3 (segments 5 to 7) with notopodia and notochaetae only, chaetigers 4 to 16 biramous with notopodia, neuropodia, notochaetae and neurochaetae, chaetiger 17 with notopodia and notochaetae only (giving ratio of number of pairs of notopodia to neuropodia 17/13). Notochaetae all smooth winged capillaries, some with hirsute surfaces and others with finely serrated margins. Neurochaetal uncini with major teeth arranged in two rows. Posterior 5 segments fused to form flattened plate or scaphe and distinctly separated from the abdomen.

Type species. *Amphitrite auricoma* Müller, 1776; subsequent designation by Hartman, 1959.

Remarks. Ten species of *Amphictene* have been described and two additional species are described in this paper. The major diagnostic features of these species are given in Table 1. Several species are poorly described and in some cases characters states have had to be assigned from non-type material. We have transferred one species previously described as *Pectinaria leioscapha* Caullery (1944) to the genus *Amphictene*, because the opercular rim is described as being cirrate.

Amphictene favona n.sp.

Figs. 2A–B, 3A–C, 4A–B, 5A–B, 6, Tables 1, 6

Amphictene crassa.–Hartman, 1966a: 363–364. *Not A. crassa* Grube, 1870.

Type material. HOLOTYPE: AM W25611, 40 mm long, 14 & 10 mm wide. PARATYPES: 2, BMNH 2001.70–71*, 68–69 mm long, 13–17 & 6–7 mm wide; 3, LACM-AHF POLY 2060*, 54–59 mm long, 14–17 & 5 mm wide; 3, USNM 187084*, 35–68 mm long, 10–21 & 5–8 mm wide; 11, AM W25403*, 40–72 mm long, 10–15 & 4–10 mm wide. All material collected by Pat Hutchings, 28.vi.1994.

Type locality. Western Australia: Abrohlos I., Wallabi Group, holotype 28°32'35.4"S 113°46'32.4"E paratypes collected from 28°32'35.4"S 113°46'32.4"E to 28°36'31.2"S 113°44'56.4"E, 45–47 m, in amongst white bleached algal nodules (Rhodoliths).

Additional material examined. WESTERN AUSTRALIA: S of islets near Gun I., South Group, 28°53'S 113°52'E, 9.iv.1976, 2, WAM 49-96*; 8 km NW of Gun I., South Group, 28°53'S 113°52'E, 11.v.1960, 56.7–64 m, coral rubble, sponge and seaweed, 3, WAM 48-96*; Point Samson, 20°38'S 117°12'E, 26.ix.1972, low tide, sandy mud, 1, AM W5493*; between Broome and Wallal, 18°58'S 122°14'E, ix.1931, 13 m, 1, AM W2842*; Ashmore Reef, 12°15'S 123°00'E, 11.ix.1986, reef flat, 1, WAM 41-96*. QUEENSLAND: No. 2, Sandbank, Michaelmas Reef, near Cairns, 16°35'S 146°02'E, 7.viii.1971, 1, AM W25404; vi.1926, 1, AM W2317*, 1, AM W2318*; Brampton I., 20°49'S 149°17'E, 1949, 1, AM W5611*; Hayman I., 20°03'S 148°53'E, 1, AM W3150*; One Tree I., 23°30'30"S 152°05'E, 4.x.1967, 1 m, 1, AM W25405*. Material examined varied from 35 to 97 mm long & 10 to 16 & 10 to 6 mm wide.

Table 1. Major distinguishing characters of species of *Amphictene* (entries in parentheses are based on non-type material); † no type designated.

species	holotype length mm	holotype anterior width mm	cephalic veil, nos. of cirri	nos. of pairs of paleae	shape of paleae	opercular rim, nos. of cirri	posterodorsal lobe (segment 2)	anteroventral lobe (chaetiger 2)
A. auricoma (O.F. Müller, 1776)	†(20–40)	(3–9)	(12–20)	(10–15; 25 on v. large animals)	(acute, elongate thin tips curled over)	(15–25)	(absent)	(present—glandular, with 2 mid ventral lobes)
A. auricoma mediterranea (Nilsson, 1928)	*n.r.*	*n.r.*	*n.r.*	*n.r.*	*n.r.*	25	*n.r.*	*n.r.*
A. capensis (Pallas, 1776)	(15–90)	(3.5)	(20–30)	(11–15)	(elongate, curved dorsally, wide)	(20–26)	(absent)	(glandular)
A. catharinensis (Grube, 1870)	31	10	(40–50)	(11–12)	(elongate)	(10)	(*n.r.*)	(glandular)
A. crassa (Grube, 1870)	40 (40–100)	15 (15–25)	32 (27–32)	12 (12–18)	wide, recurved (acute)	56 (50–60)	*n.r.*	*n.r.* (cirrate—24)
A. favona n.sp.	40 (35–97)	7–17 (10–26)	28 (23–25)	12	subacute, blunt, curved dorsally	62 (61–63)	present, well developed, scalloped slightly	cirrate: 24 (23–25) broad triangular appendages
A. guatemalensis (Nilsson, 1928)	11	*n.r.*	20	9	curved dorsally, rolled tip	13	*n.r.*	cirrate—6 cirri per side
A. japonica (Nilsson, 1928)	incomplete (3–60)	8	v. small, unable to count (12–14)	13–14 (10–12)	curved (thick, flat, distally pointed)	24 (21–25)	*n.r.*	glandular
A. leioscapha (Caullery, 1944)	*n.r.*	*n.r.*	20	10	acute tips	with denticles	*n.r.*	*n.r.*
A. moorei (Annenkova, 1929)	32	*n.r.*	35–40	12	short curved, with fine tips	*n.r.*	*n.r.*	wide, and lobed
A. souriei (Fauvel, 1949)	63	7	long (many)	11–12	filiform tip	40	absent	glandular
A. uniloba n.sp.	29 (20–45)	4–2 (4–6)	16 (11–21)	14 (10–16)	subacute, curved dorsally, elongate	26 (21–31, nos. size dependent)	absent	glandular, smooth

Table 1 (continued). Major distinguishing characters of species of *Amphictene* (entries in parentheses are based on non-type material).

species	chaetigers on which notopodia reduced	nos. of rows of teeth per uncinus	nos. of teeth within a row on uncinus	scaphal shape	scaphe: anal flap	scaphal hooks: nos. of pairs & type	tube, shape & construction	glandular areas	type locality	additional records and comments*
A. auricoma s.st.	(1–3)	(3)	(5–6)	(elongate, longer or long as wide, crenulate edge)	(twice as long, or longer than wide; with long cirrus)	(8–18; size dependent; distally curved)	(curved, black—grey sand grains)	(strongly glandular)	Denmark—"type is probably lost or never designated" (Holthe, 1986)	(See below) [a]
A. a. mediterranea	*n.r.*	2	7–8	as long as broad, crenulate edge	short, as long as broad with small cirrus	10–16	dark brown, a variety of forms (locality dependent)	strongly glandular	Naples, Palmero & Pischio, Mediterranean Sea	(See below) [b]
A. capensis	(1–3)	(2–3)	(6–8)	(broader than long, oval, lobed margin)	(small shield shaped with small cirrus often missing)	(5–8)	(straight—made of sponge spicules)	(*n.r.*)	Cape of Good Hope	(See below) [c]
A. catharinensis	(1–3)	(2)	(6–7)	(*n.r.*)	(*n.r.*)	(20)	(*n.r.*)	(strongly glandular)	Desterro, Brazil	Redescribed by Nilsson (1928).
A. crassa	*n.r.* (1–3)	1? (2)	8–10 (6–10)	broader than long, lobed, 6 sided	*n.r.* (crenulated margin with small cirrus)	10 (6–20)	curved (coarse grains, thin walled)	*n.r.* (strongly glandular)	New Caledonia	(See below) [d]
A. favona n.sp.	1–3 & 15–18	2	7–8	broader than long, crenulated	present	16, broad, golden brown, blunt	straight, pale shell fragments	strongly glandular on chaetigers 4–18	Wallabi Group, WA, Australia	See Fig. 5 for distribution.
A. guatemalensis	1–3	4–5	6	wide-oval, lobed edges	semi-circular, lobed—no cirrus	9–10	*n.r.*	glandular	West coast of Central America, Guatemala	Known only from original description.
A. japonica	*n.r.*	2	7 (8)	missing (oval)	missing (smooth margin)	25 (9–24)	*n.r.*	strongly glandular	Japan	(See below) [e]
A. leioscapha	1–3, 17	2–3	8	broader than long	tongue-shaped with small cirrus	12	sand grains and forams	*n.r.*	Banda, Indonesia	Known only from single specimen.
A. moorei	*n.r.*	1	6–7	oval with lobed margins	short, wide & smooth with small cirrus	9–10	curved, brown grains, clear cement	*n.r.*	East coast of Siberia 132–159.7 m	Known only from original description.
A. souriei	none	2	6–7	long, oval with lobed edges	triangular, no anal cirrus present	6–7	straight, small round sand grains	*n.r.*	Hann Beach, Dakar, West Africa	(See below) [f]
A. uniloba n.sp.	1–3 & 15–18	2	8	broader than long, convoluted margin	present with small cirrus	6 (4–10), fine, small brown	straight, brownish, clear sand grains	strongly glandular	Jibbon Beach near Cronulla, NSW, Australia	See Fig. 5 for distribution.

n.r. character not recorded.

* Only a selection of records are given based on the literature to indicate distribution of species; however distributions outside the region of the type locality require verification.

[a] [*auricoma*] Widely recorded from Sweden and Norway (Malmgren, 1866, 1867); Gulf of Naples (Claparède, 1868); North Sea (Fauvel, 1927); Swedish west coast, 20–30 m (Hessle, 1917); Atlantic Ocean, Arctic Sea, Northern Pacific Ocean (Nilsson, 1928); Mediterranean Sea (Annenkova, 1929); Scandinavia (Holthe, 1986). Notochaetae with finely denticulate tips. Considerable variation recorded for this species.

[b] [*auricoma mediterranea*] Nilsson (1928) synonymised *Amphictene auricoma* described by Claparède (1868), Marenzeller (1874) and Panceri (1875); and *P. auricoma* described by Grube (1850, 1861, 1864) and Lo Bianco (1893) with his new subspecies, all records from the Mediterranean Sea. Not recorded since.

[c] [*capensis*] Recorded from S & E coast of Africa in 1298 m (Nilsson, 1928; Day, 1955, 1967). Some notochaetae with finely serrated tips.

[d] [*crassa*] Recorded from New Caledonia, Palau, Sri Lanka (Nilsson, 1928), India (Fauvel, 1953). Record by Hartman (1966a) from Sydney referred to *A. favona* (this study).

[e] [*japonica*] Also recorded by Imajima & Hartman (1964) from Japan. Some notochaetae with finely denticulate tips.

[f] [*souriei*] Known only from original description– distinguished by 4 large tubercules on the dorsum at level of branchiae. Some notochaetae with finely denticulated tips.

Other material examined. Holotype of *Pectinaria (Amphictene) crassa* Grube, 1870, ZMB 5704, New Caledonia.

Description. Preserved specimen pale cream to grey in colour. Body, robust and solid. Tube forming slightly tapered cylinder, resembling a tusk, composed of cemented shell fragments.

Rim of cephalic veil with 28 long cirri; cirri basally triangular, tapering to form thread-like terminal filaments. Cephalic veil completely free from operculum forming dorsal semi-circular lobe, which covers the bases of numerous peristomial palps. Raised opercular margin well developed, crenulated with 62 triangular lappets. Operculum with 12 pairs of paleae, short, golden, subacute, curved dorsally, without extended tips (Fig. 2A).

First pair of tentacular cirri arise from posterolateral margin of segment 2. Second pair of tentacular cirri present on segment 3, arise from a connecting ridge, which runs across the venter, margins of which expanded to form thin, flattened, rounded flaps. Segment 2 with posterodorsal lobe present and with scalloped margin. Venter of segments 3 and 4 slightly glandular and smooth. Chaetiger 1 (segment 5) without an anteroventral lobe. Chaetiger 2 with anteroventral lobe large and broad, anterior margin of lobe with contiguous rounded papillae, 24 present (Fig. 2A).

Two pairs of comb-like stalked branchiae on segments 3 and 4, situated laterally and each consisting of a series of loose, flat lamellae; anterior pair attached more ventrally than posterior pair, larger than posterior pair. Branchiae lie flattened against the body. Large subquadrate glandular flaps present ventrally at base of second pair of branchiae on segment 4.

Chaetigers 1 to 3 (segments 5 to 7) with notopodia only. Chaetigers 4 to 16, biramous with notopodia, neuropodia, notochaetae and neurochaetae. Chaetiger 17 with notopodia and notochaetae only. Chaetigers 1 to 3 and 15 to 17 with both notopodia and notochaetae reduced in length compared to those on chaetigers 4 to 14. All notochaetae smooth-winged capillaries with finely hirsute surfaces and some margins slightly pectinate (Fig. 4A–B), some notochaetae straight, others with slightly curved tips (Figs. 3A, 4A–B). Neuropodia wedge-shaped, slightly glandular, erect tori, with numerous neurochaetae. Neurochaetal uncini with major teeth arranged in two longitudinal rows, each with 8 to 10 teeth, with size of teeth declining basally (Figs. 3B–C, 5A).

Posterior 5 segments fused to form scaphe broader than long; distinctly separated from preceding abdomen. Scaphe with lobed margins, and an anal flap with a dorsal papilla present (Fig. 2B). Scaphal hooks present, 16 pairs; broad, blunt, golden-brown (Fig. 5B).

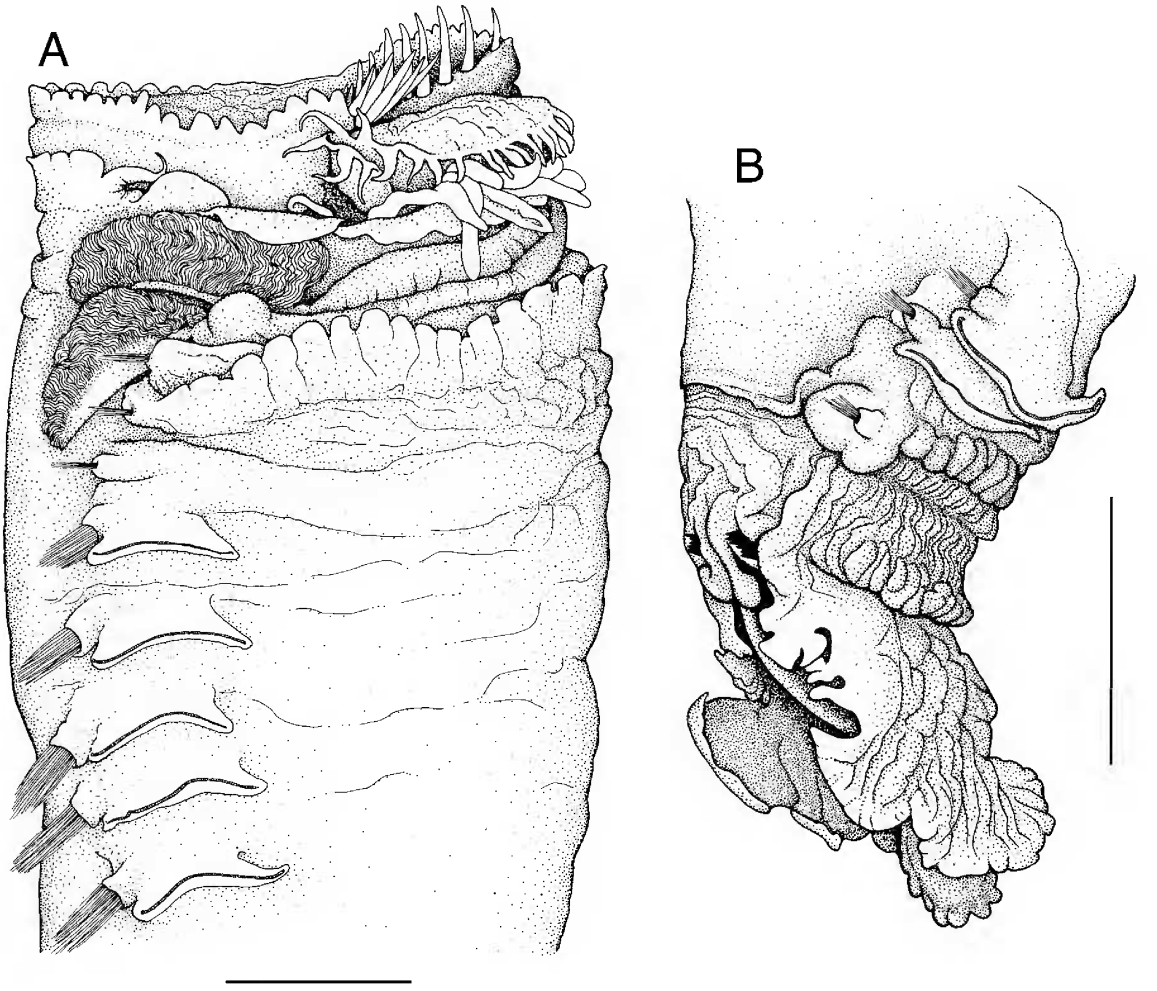

Figure 2. *Amphictene favona* n.sp. A, lateral view of anterior end of holotype (AM W25611). B, posterior end of paratype (AM W25403). Scales = 5 mm.

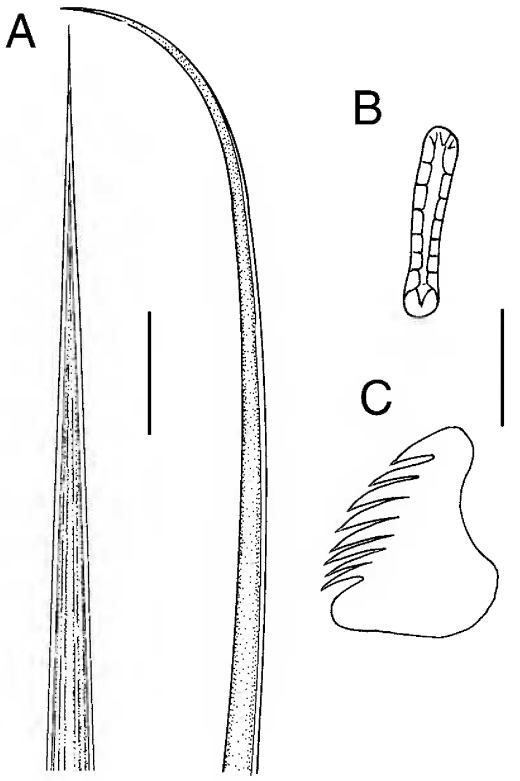

Figure 3. *Amphictene favona* n.sp. Holotype (AM W25611). A, two types of notochaetae from chaetiger 5. B, frontal view of neurochaeta from 8th uncinigerous segment. C, lateral view of neurochaeta from 8th uncinigerous segment. Scales = 100 µm.

Chaetigers 4 to 18 with prominent paired, ventral glandular patches, rectangular with rounded margins. Small thin, film-like flaps present on second prescaphal segment.

Nephridial papillae present on segments 5 and 6 (chaetigers 1 and 2), rounded, situated ventrolaterally below base of second pair of branchiae.

Variation. Some immature individuals have only one pair of nephridial papillae present on chaetiger 1, two pairs present on mature individuals. Within the material examined, the number of cirri on the cephalic veil margin varies between 23 and 28, with larger animals having more cirri than smaller ones. In addition, the number of lappets on the opercular margin varies from 61 to 63 and the number of papillae on the anteroventral lobe of chaetiger 2 varies from 23 to 25; in general the higher counts are present on larger animals. The orientation of the branchiae varies between individuals, some have the branchiae completely flattened against the body whereas in others they are held away from the body. This may be an artifact of preservation, or a real difference among individuals.

Remarks. *Amphictene favona* n.sp. can be distinguished from all other described species of *Amphictene* (see Table 1) by the following combination of characters: relatively few cirri on the cephalic veil (23 to 28), large numbers of cirri on the operculum (61 to 63), and 16 pairs of scaphal hooks, with relatively little variation occurring between large and small individuals. The number of pairs of scaphal hooks distinguishes this species from all other described species. *Amphictene favona* most closely resembles *A. capensis* (Pallas, 1776), *A. uniloba* n.sp., *A. crassa* (Grube, 1870) and *A. japonica* (Nilsson, 1928) in terms of sharing one of its diagnostic characters.

Hartman (1966a) recorded *Amphictene crassa* from Australia, giving no locality data. The specimen was brought into the Australian Museum for identification by a member of the public. Re-examination of this specimen (AM W3802) showed that it is *Amphictene favona* n.sp. and not *A. crassa*, so no valid records for the latter species exist from Australian waters. The specimen was most likely collected in New South Wales, extending the known range of the species (but not indicated on Fig. 6, due to the uncertain nature of the record). The individual was compared with the type of *A. crassa* (Grube, 1870) (ZMB 5704), which was described from New Caledonia and differs from this species in having fewer pairs of scaphal hooks. The records of this species from Palau, Sri Lanka (Nilsson, 1928) and those from India (Fauvel, 1953) may also be misidentifications.

Etymology. The specific name *favona* refers to the westerly winds, which blow almost continually on the Abrohlos Islands, and is based on the latin word for "west wind".

Distribution. Northeastern Australia and northwestern Australia (see Fig. 6).

Habitat. Found in depths ranging from intertidal to 64 m, in soft sediments, often in amongst bleached algal nodules and typically associated with coral reefs.

Amphictene uniloba n.sp.

Figs. 4C–D, 5C–D, 6, 7A–B, 8A–C, Tables 1, 6

Type material. HOLOTYPE: AM W25612*, 29 mm long, 4 & 2 mm wide. PARATYPES: 3, AM W25613*, 28–33 mm long, 5–6 & 2–3 mm wide; 2, BMNH 2001.68–69*, 31–32 mm long, 5–6 & 2–3 mm wide; 2, LACM-AHF POLY 2059*, 20–32 mm long, 5 & 3 mm wide; 2, USNM 187085 *, 28–35 mm long, 5 & 3 mm wide. All material collected by John McIntyre, 5.xii.1965.

Type locality. New South Wales: near Cronulla, Jibbon Beach, 34°03'S 151°09'E, 60–100 m.

Additional material examined. QUEENSLAND: Pallarenda Beach, N of Townsville, 19°12'S 146°46'E, 11.xi.1977, 0.1 m, 1, AM W18121*. NEW SOUTH WALES: Port Stephens, 32°42'S 152°06'E, ix.1908, 1, AM G11197*. Material examined varied from 20 to 45 mm long & 4 to 6 mm & 2 to 3 mm wide.

Description. Preserved specimen grey to pale cream in colour; small, conical in shape. Tube straight, composed of cemented sand grains.

Rim of cephalic veil with 16 long, narrow, triangular cirri, tapering, with thread-like tips. Cephalic veil completely free from operculum forming dorsal semi-circular lobe covering bases of numerous peristomial palps present. Raised opercular margin well developed, divided into 24 triangular lappets. Operculum with 14 pairs of paleae, long, yellow-gold, subacute, curved dorsally, with extended tips (Fig. 7A).

First pair of tentacular cirri arise on anterior margin of segment 2. Second pair of tentacular cirri present on segment

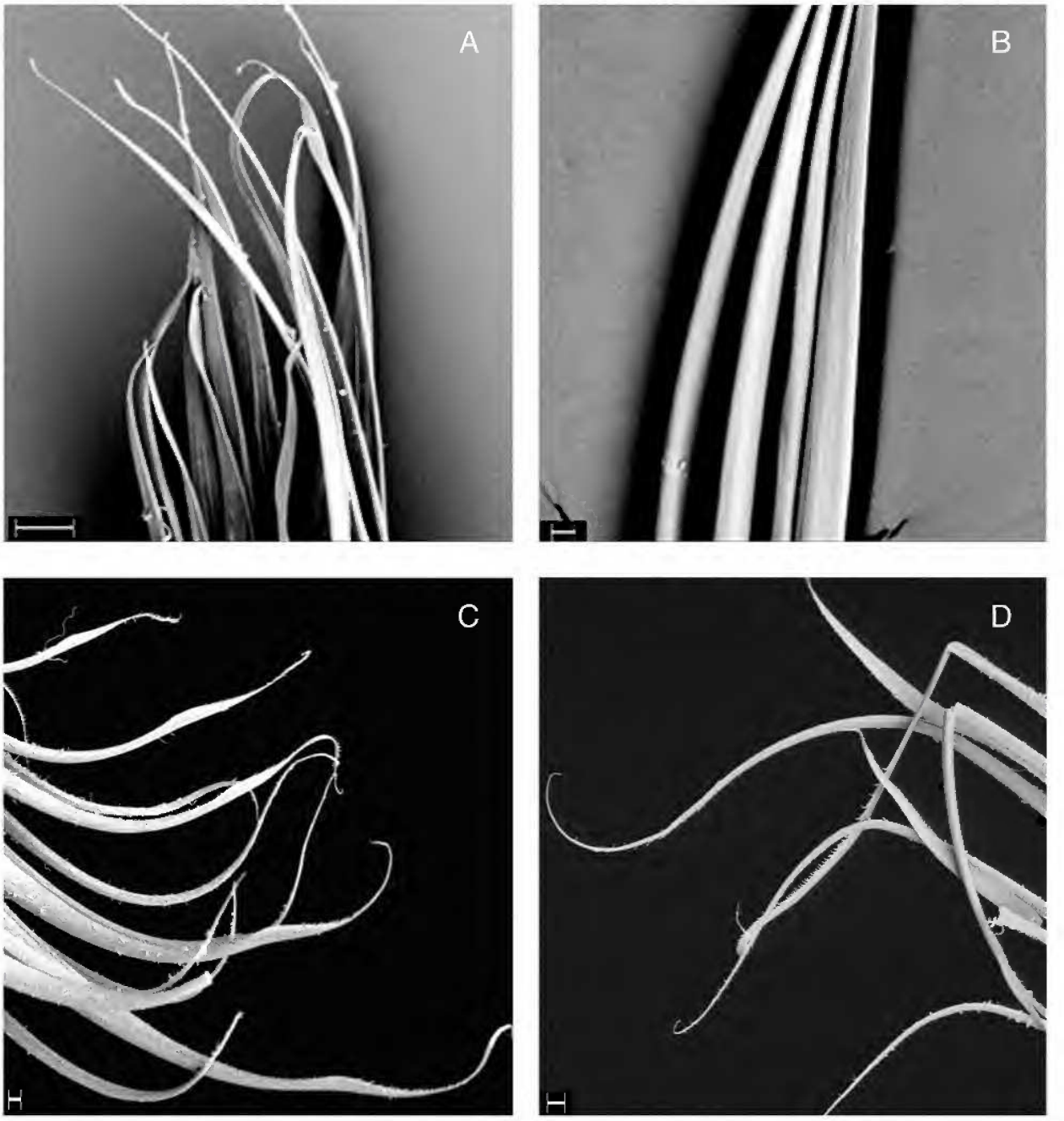

Figure 4. A, *Amphictene favona* n.sp. notochaetae from chaetiger 4, scale = 100 µm. B, *Amphictene favona* n.sp. notochaetae from chaetiger 14, scale = 10 µm. C, *Amphictene uniloba* n.sp. notochaetae from chaetiger 4, scale = 10 µm. D, *Amphictene uniloba* n.sp. notochaetae from chaetiger 14, scale = 10 µm.

3, arise from a connecting ridge which runs across the venter, margins of ridge incised forming glandular lobes. Segment 2 without anterodorsal lobe. Chaetiger 2 (segment 6) with large, anteroventral lobe, broad, with anterior margin of lobe smooth, lobe thin and almost transparent.

Two pairs of comb-like, stalked branchiae on segments 3 and 4, situated laterally and consisting of loose flat, lamellae. Anterior pair situated more ventrally than posterior pair, and larger than posterior pair. Branchiae lie flattened against the body.

Chaetigers 1 to 3 (segments 5 to 7) with notopodia only. Parapodia biramous with both notopodia, neuropodia, notochaetae and neurochaetae on chaetigers 4 to 16. Chaetiger 17 with notopodia and notochaetae only. Notopodia of chaetigers 1 to 3 and 15 to 17 reduced in size, and associated notochaetae also reduced in size and length compared to notosetae on chaetigers 4 to 14. All notochaetae simple, smooth-tipped capillaries, with finely hirsute surfaces, and varying from ones with finely pointed tips to those with strongly curved tips and some with pectinated margins (Figs. 4C–D, 8A), all of which may be present in the same fascicle. Neuropodia wedge-shaped, slightly glandular, erect tori with numerous neurochaetae. Neurochaetal uncini with major teeth arranged in two longitudinal rows of teeth each with about 8 teeth per row, with size of teeth declining basally (Figs. 5C, 8B–C).

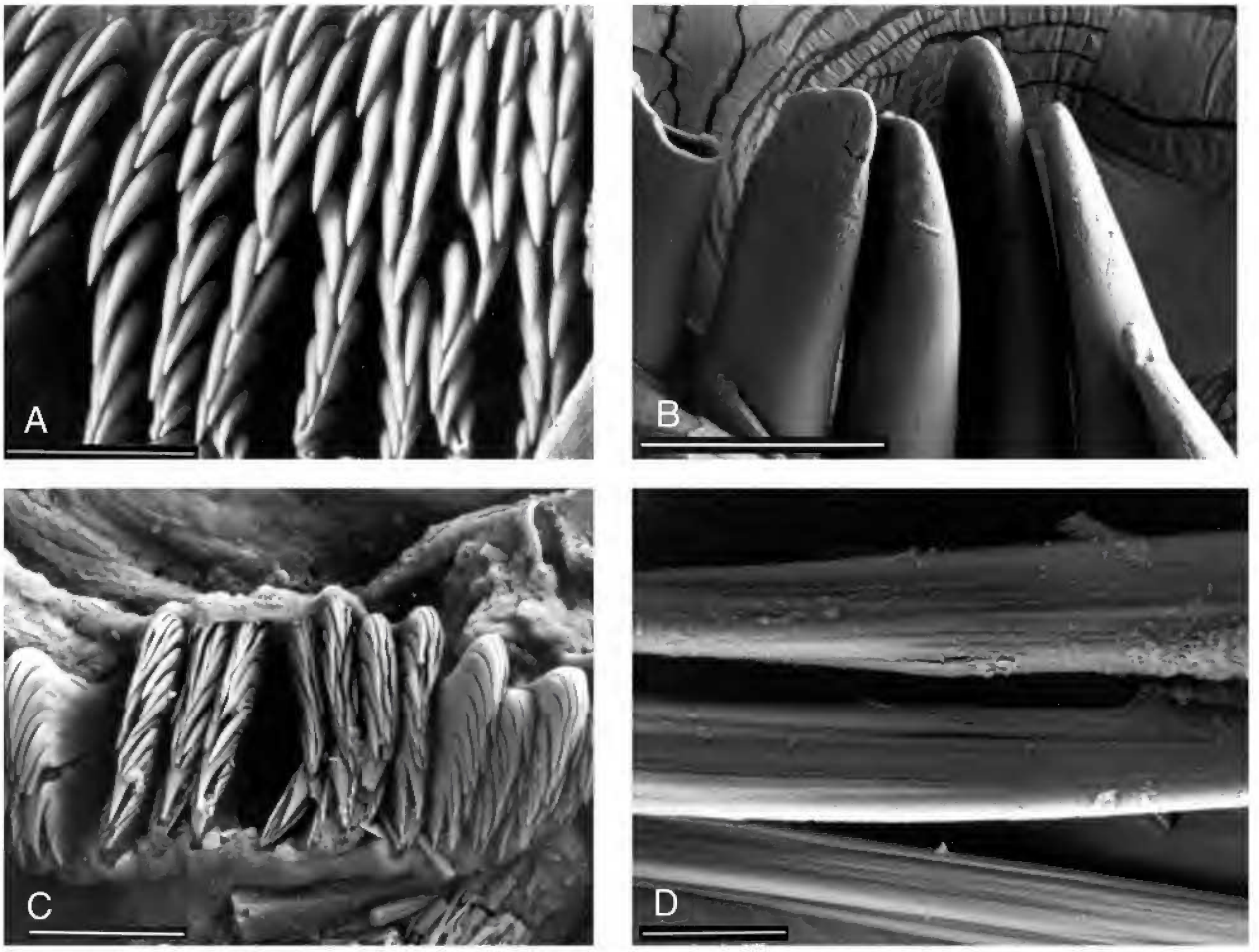

Figure 5. A, *Amphictene favona* n.sp. neurochaetae from chaetiger 8, scale = 20 µm. B, *Amphictene favona* n.sp. scaphal hooks, scale = 100 µm. C, *Amphictene uniloba* n.sp. neurochaetae from chaetiger 8, scale = 20 µm. D, *Amphictene uniloba* n.sp. scaphal hooks, scale = 3 µm.

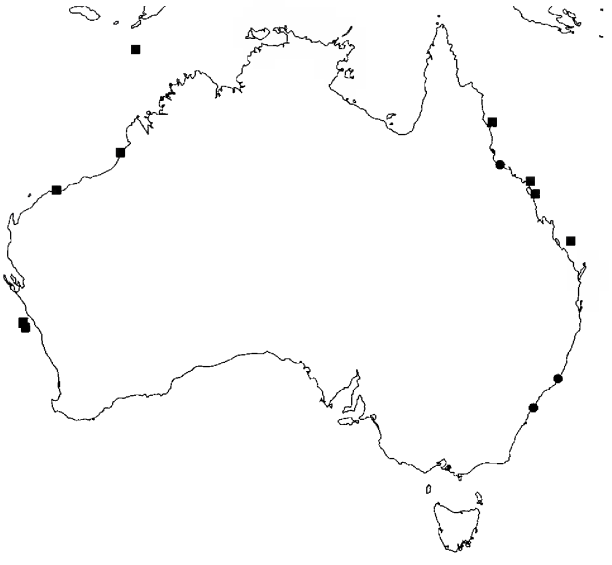

Figure 6. Distributional map for the Australian species of *Amphictene*. ■ *Amphictene favona* n.sp. ● *Amphictene uniloba* n.sp.

Posterior 5 segments fused to form a flattened plate or scaphe, broader than long. Scaphe with an anal flap and dorsal papilla present, and with crenulated, lobed margins (Fig. 7B). Scaphal hooks present, 6 pairs, fine, small and brown (Fig. 5D).

Venter of segments 1 to 6 glandular, raised and corrugated. Chaetigers 7 to 20 with prominent oval to rectangular glandular patches present ventrolaterally. Nephridial papillae present on segment 5 (chaetiger 1), situated ventrolaterally just below base of second pair of branchiae.

Variation. The number of cirri on the cephalic veil ranges from 11 to 21; the number of triangular lappets on the raised opercular margin varies from 21 to 31 lappets; the relative size of the two pairs of branchiae differ, either being similar in size or with the anterior pair larger. The number of pairs of scaphal hooks varies from 4 to 10 and the development of the glandular areas varies between individuals. Larger animals have more cirri, lappets and scaphal hooks than smaller animals. The relative proportions of the scaphe varies between individuals. It may be as long as broad or longer than broad. This may be an artifact of preservation.

Remarks. *Amphictene uniloba* n.sp. can be distinguished from all other described species of *Amphictene* by the following combination of characters: relatively small

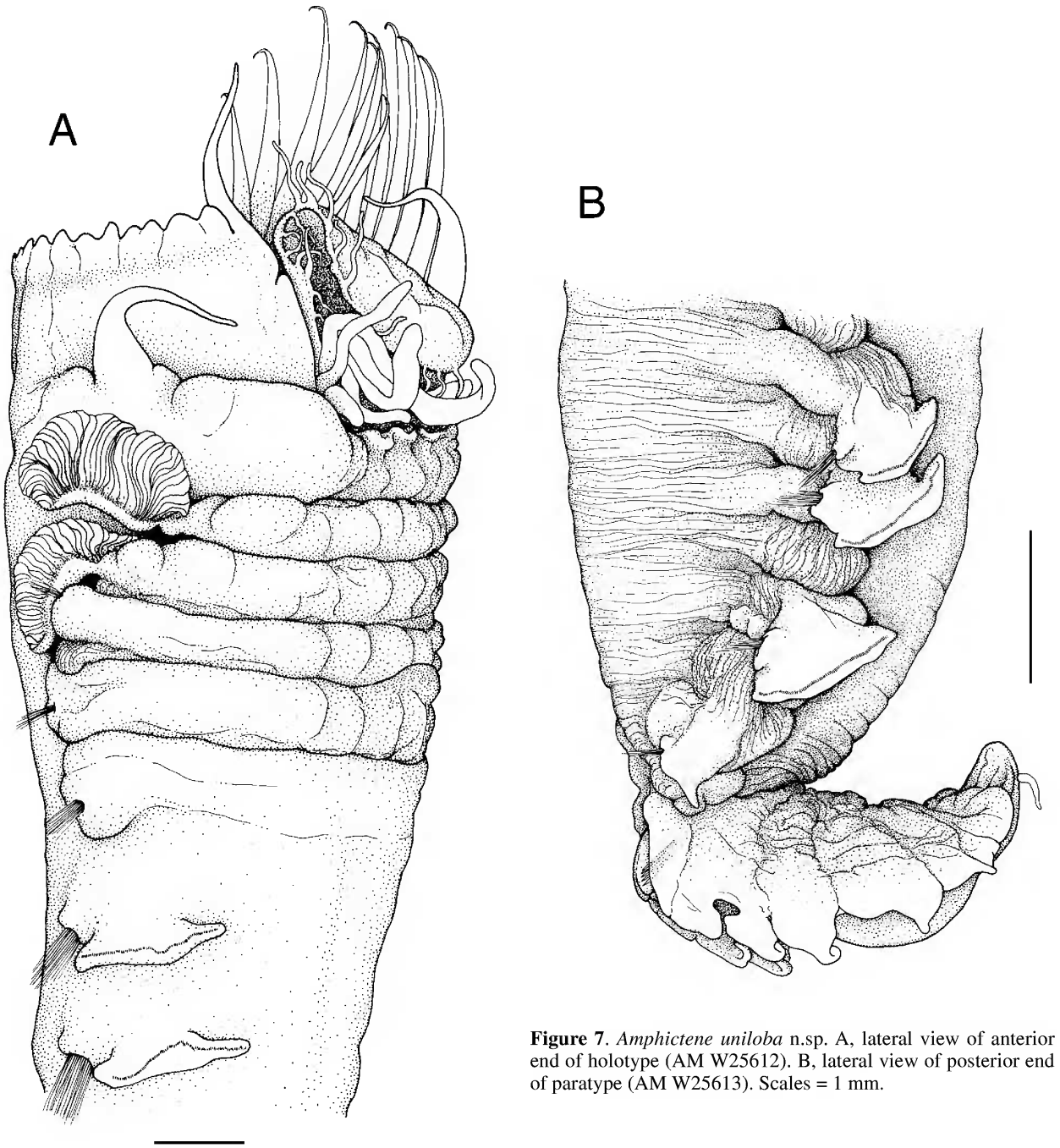

Figure 7. *Amphictene uniloba* n.sp. A, lateral view of anterior end of holotype (AM W25612). B, lateral view of posterior end of paratype (AM W25613). Scales = 1 mm.

number of cirri on the cephalic veil (11 to 21), 14 pairs of paleae and 4 to 10 pairs of scaphal hooks present (see Table 1). The species most closely resembles *A. japonica* Nilsson, 1928, in terms of the number of cirri on the cephalic veil but differs in the number of pairs of paleae present. Table 1 shows that several described species are poorly known with no indication given of the amount of variation exhibited for individual characters. This study, which examined a large amount of material, revealed that some characters such as the number of cirri on the cephalic veil, the number of pairs of cirri on the opercular rim and the number of pairs of scaphal hooks vary according to size of the individual and thus presumably with age. Future studies of the group must consider these size related variations.

Amphictene uniloba can be distinguished from the other Australian species *A. favona* by the number of cirri present on the cephalic veil. *Amphictene uniloba* has fewer cirri (11 to 21) than *A. favona*, which has 23 to 28, and the number of pairs of paleae differs, *A. uniloba* having 14 and *A. favona* having 12 pairs. Both species occur on the east coast of Australia but *A. favona* also occurs on the northwest coast (see Fig. 6).

Etymology. The specific name *uniloba* refers to the single anteroventral lobe present on chaetiger 2 and is derived from the latin word unus.

Distribution. Eastern Australia; known only from Jibbon Beach, Port Stephens, NSW and Townsville, Qld (Fig. 6).

Habitat. Intertidal to 100 m depth, no sediment data available.

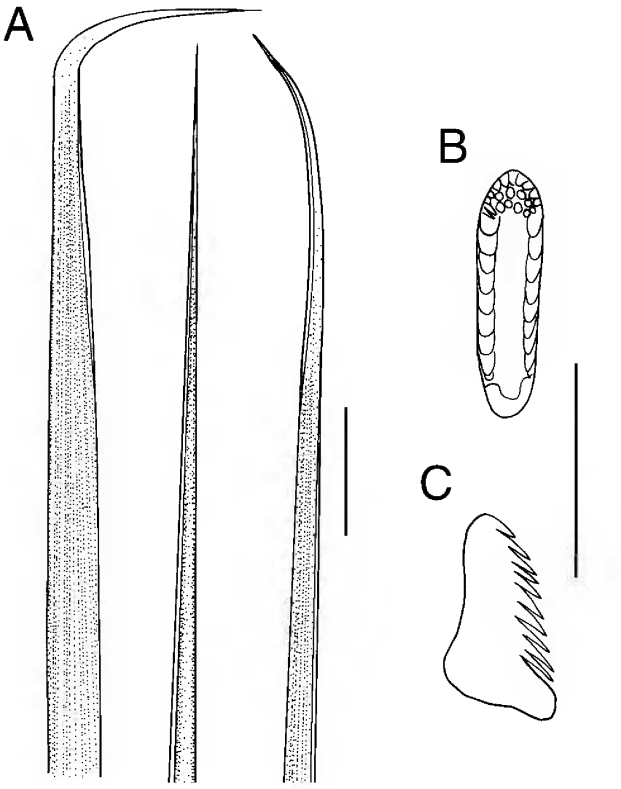

Figure 8. *Amphictene uniloba* n.sp. Holotype (AM W25612). A, three types of notochaetae from chaetiger 5, scale = 100 μm. B, frontal view of neurochaeta from 8th uncinigerous segment. C, lateral view of neurochaeta from 8th uncinigerous segment. Scale for B and C = 25 μm.

Cistenides Malmgren, 1866

Tables 2, 6

Cistenides Malmgren, 1866: 358.–Hartman, 1941: 328.–Fauchald, 1977: 120.

Diagnosis. Rim of cephalic veil with numerous long cirri. Cephalic veil completely free from operculum, forming dorsal semi-circular lobe covering bases of numerous peristomial palps. Raised opercular margin smooth. Chaetigers 1 to 3 (segments 5 to 7) with notopodia and notochaetae only, chaetigers 4 to 16 biramous with notopodia, neuropodia, notochaetae and neurochaetae, chaetiger 17 with notopodia and notochaetae only (17/13). Notochaetae all smooth capillaries. Neurochaetal uncini with major teeth arranged in one row. Posterior 5 segments fused, forming flattened plate or scaphe, distinctly separated from abdomen.

Type species. *Sabella granulata* Linnaeus, 1767, designated by Hartman (1959).

Remarks. The genus has not been recorded from Australian waters. The major diagnostic characters of the six species assigned to this genus are given in Table 2. Species have been separated using the following characters: number of cirri on the cephalic veil, and the number and shape of paleae and scaphal hooks. For several species, the characters are described from non-type material as the original species description is poor. The distinguishing generic character is the presence of a single row of teeth on the uncini. Four species previously referred to the genus *Cistenides, C. aegyptia* Savigny, 1818, *C. chilensis* Nilsson, 1928, *C. gouldii* Verrill, 1874 and *C. regalis* Verrill, 1900, have uncini with two rows of teeth according to the literature and are transferred to the genus *Pectinaria*. *Cistenides hyperborea* Malmgren, 1866, is poorly known, and the type description does not indicate the number of rows of teeth present on the uncini, although 1 to 3 rows of teeth have been recorded on other material assigned to this species. Material from the species type locality of Greenland needs to be re-examined to ascertain the generic identity of this species. Holthe (1986) suggests that no type material exists and probably was never designated. All species now recognised as belonging to the genus occur only in the Northern Hemisphere and often in cold water.

Lagis Malmgren, 1866

Tables 3, 6

Lagis Malmgren, 1866: 360.–Fauchald, 1977: 120.–Holthe, 1986: 18.

Diagnosis. Rim of cephalic veil with numerous long cirri, at least partially fused to operculum. Cephalic veil semi-circular, covering the bases of numerous peristomial palps. Raised opercular margin smooth. Chaetigers 1 to 3 (segments 5 to 7) with notopodia and notochaetae only, chaetigers 4 to 15 biramous with notopodia, notochaetae, neuropodia and neurochaetae, chaetiger 16 with notopodia and notochaetae only (16/12). Notochaetae all smooth capillaries. Neurochaetal uncini with major teeth arranged in two or more rows. Posterior 5 segments fused, forming flattened plate or scaphe, [as for *Cistenides*] and distinctly separated from the abdomen.

Type species. *Lagis koreni* Malmgren, 1866, by original designation.

Remarks. The genus has not been recorded from Australian waters, although *L. australis* (Ehlers, 1904) was described from New Zealand. We have examined material from the type locality and used this to complete the entry for this species in Table 3. The major diagnostic characters of the species assigned to this genus are given in Table 3. Currently ten species are known. Characters such as the number of cirri on the cephalic veil, numbers and types of paleae and scaphal hooks, as well as the numbers of rows of teeth on the uncini are used to distinguish species. However, as is clear from Table 3, some of these diagnostic characters exhibit ranges, which may make the separation of species difficult, although species appear to have non-overlapping geographical distributions. Five species are known only from type material. We have reassigned *Pectinaria bocki* Hessle, 1917 to this genus because the uncini have four rows of teeth.

Species of this genus have been reported from many localities around the world.

Pectinaria Savigny in Lamarck, 1818

Tables 4, 6

Pectinaria Savigny in Lamarck, 1818: 348.–Hartman, 1941: 329.–Fauchald, 1977: 120.– Hartman, 1959: 479.–Holthe, 1986: 20–21.

Diagnosis. Rim of cephalic veil with numerous long cirri. Cephalic veil completely free from operculum, forming a dorsal semi-circular lobe covering the bases of numerous peristomial palps. Raised opercular margin smooth. Chaetigers 1 to 3 (segments 5 to 7) with notopodia and notochaetae only, chaetigers 4 to 16 biramous with notopodia, neuropodia, notochaetae and neurochaetae, chaetiger 17 with notopodia and notochaetae only (17/13). Two types of notochaetae, smooth and serrated (or plumose). Neurochaetal uncini with major teeth arranged in two rows. Posterior 5 segments fused to form a flattened plate or scaphe and distinctly separated from the abdomen.

Type species. *Nereis cylindraria belgica* Pallas, 1766, designated by Hartman (1959).

Remarks. Savigny worked at the Museum d'Histoire Naturelle in Paris. He wrote a description of the genus *Pectinaria* in 1809 and completed the plates in 1812, but it was not until 1822, that the manuscript was published with no major modifications. During the intervening years, Lamarck, who also worked at the Museum in Paris and was the superior of Savigny, had access to this unpublished manuscript and he published the name *Pectinaria* in 1818. Some workers have therefore quoted the authority of the genus as Lamarck (Lucas & Holthuis, 1975) but because Savigny actually made the description, we therefore quote it as Savigny in Lamarck, 1818. Another complication is that Leach (1816) described the genus *Cistena* and referred *Nereis cylindraria* Pallas to his new genus, and Lucas & Holthuis (1975) believed that this was a reference to the var. *belgica*. *Lagis koreni* is the only common pectinariid on the west coast of Holland where Pallas worked. Lucas & Holthuis (1975) designated a lectotype of Pallas's *Nereis cylindraria belgica*. The name *koreni* Malmgren, 1866, as published in the combination *Lagis koreni*, then became a junior subjective synonym of the name *belgica* Pallas, 1766, the type species of *Pectinaria* (*Nereis cylindraria belgica*). The synonymising of *P. koreni* and *P. belgica* was objected to by Nielsen *et al.* (1977) who made a submission to the International Commission on Zoological Nomenclature to stabilise the names of *Pectinaria belgica* (Pallas, 1766) and *Pectinaria koreni* (Malmgren, 1866). They provided evidence that both names had been used by marine biologists for over 100 years, and their submission was accepted (Nielsen *et al.*, 1977). For further details, see Lucas & Holthuis (1975) and Nielsen *et al.* (1977).

Twenty species of *Pectinaria* have been described, including four species originally described as Cistenides that we have transferred to *Pectinaria*. Two additional species are described in this paper. The major diagnostic features of these species are given in Table 4. Several of these species are poorly described and, in some cases, characters states have had to be assigned from non-type material.

Table 2. Major distinguishing characters of species of *Cistenides* (entries in parentheses are based on non-type material).

species	holotype length mm	holotype anterior width mm	cephalic veil, nos. of cirri	nos. of pairs	shape of paleae	posterodorsal lobe (segment 2)	anteroventral lobe (chaetiger 2)
C. brevicoma Johnson, 1901†	(31)	(*n.r.*)	33 (28–30)	10–12 (12–13)	short, stout, iridescent	*n.r.*	glandular
C. ehlersi (Hessle, 1917)	*n.r.* (15–31)	*n.r.* (3)	25 (20–30)	12 (8–15)	*n.r.* (spiral-tipped, rolled top)	*n.r.*	corrugated (*n.r.*)
C. granulata (Linnaeus, 1767)	*n.r.* (24–65)	*n.r.* (7–8)	*n.r.* (30–50)	*n.r.* (7–10)	*n.r.* (acute, blunt tips, elongate, curved dorsally)	*n.r.*	*n.r.* (glandular)
C. hyperborea Malmgren, 1866†	23–28 (13–55)	6–10	32–34 (26–35)	12–14 (10–15)	flat, attenuated flexible tips (coiled tips)	absent	glandular
C. okudai Imajima & Hartman, 1964	18–24	3–5	10–15	13–16	distally incurved and faintly serrated	*n.r.*	glandular
C. soldatovi Annenkova, 1929	18–20	*n.r.*	20–30	10–13	curved tips	*n.r.*	glandular

† no holotype designated, rather a range from the type series.

Table 2 (continued). Major distinguishing characters of species of *Cistenides* (entries in parentheses are based on non-type material).

species	chaetigers on which notopodia reduced	nos. of rows of teeth per uncinus	nos. of teeth within a row on uncinus	scaphal shape	scaphe: anal flap	scaphal hooks: nos. of pairs & type	tube, shape & construction	glandular areas	type locality	additional records and comments*
C. brevicoma	*n.r.* (1–3, 16–17)	*n.r.* (1)	4–5 (4)	broadly ovate (broader than long)	*n.r.* (broadly rounded, entire margin with small cirrus)	*n.r.* (8–10, distally hooked)	curved, coarse sand grains	*n.r.*	Puget Sound, W. coast of USA—18.3 m	Recorded from Mexico, California, USA (Hartman, 1941).
C. ehlersi	*n.r.* (1–3)	1	3–4	rectangular, lobed margin	longer than wide with short cirrus	10 (6–10)	(slightly curved distally brown in colour)	*n.r.* (glandular)	Tierra del Fuego (Feuerland), Argentina—Puerto Harberton, Strait of Magellan	(See below) [g]
C. granulata	*n.r.* (1–3)	*n.r.* (1)	*n.r.* (3–4)	*n.r.* (wide-oval, lobed edge)	*n.r.* (wider than long with small cirrus)	*n.r.* (6–10)	curved, long coarse sand grains, dark coloured	*n.r.* (strongly glandular)	Northern Europe—type probably never designated (Holthe, 1986)	(See below) [h]
C. hyperborea†	1–3; 12–17	*n.r.* (1–3)	3 (4–6)	wide, oval (longer than broad)	*n.r.* (wider than long plus small cirrus)	*n.r.* (5–9)	slightly curved, brown (sand grains, dark brown)	glandular	Greenland and Spitzbergen—"type probably lost or never designated" (Holthe, 1986)	(See below) [i]
C. okudai	*n.r.*	*n.r.*	8–9	ellipsoidal, recurved ventrally, lobed margin	crenulate margin with cirrus	12–13	*n.r.*	*n.r.*	Japan	(See below) [j]
C. soldatovi	*n.r.*	1	4	oval, lobed margin	wide, flat, no anal papilla	5–6	curved, sand grains, brown	*n.r.*	Sea of Japan	Known only from original description.

n.r. character not recorded.

† Based on original description.

* Only a selection of records are given based on the literature to indicate distribution of species, however distributions outside the region of the type locality require verification.

[g] [*ehlersi*] Recorded from Puerto Harberton, Argentina (as *Pectinaria belgica* by Ehlers, 1901—*fide* Hessle, 1917); Puerto Harberton & Ultima Esperanza, Argentina (Nilsson, 1928); Strait of Magellan, shallow to 300 m, 485 m, Drake Passage 384–494 m (Hartman, 1966b; 1967).

[h] [*granulata*] Recorded from Arctic Sea (Hessle, 1917; Nilsson, 1928); northern USSR (Annenkova, 1929), east Greenland, Iceland, Faeroes, Finnmark, Spitzbergen (Holthe, 1986).

[i] [*hyperborea*] Recorded from Norway (Hessle, 1917); northern Arctic Seas, Northern Japan, Atlantic Ocean (Nilsson, 1928); Bering Sea, Spitzbergen, Siberia (Annenkova, 1929—this record indicates the presence of 2–3 rows of teeth on the uncini which puts this in the genus *Pectinaria*); Japan, NW Europe, North Atlantic, Arctic (Imajima & Hartman, 1964); east Greenland, Iceland, the Faeroes, Finnmark, Spitzbergen (Holthe, 1986).

[j] [*okudai*] Known only from original material collected by Okuda (1938) and recorded as *Pectinaria* sp.

Pectinaria antipoda Schmarda

Figs. 9A–B, 10A–C, 12A–B, 13, Tables 4, 6

Pectinaria antipoda Schmarda, 1861: 46.–Nilsson, 1928: 69–73.–Knox & Cameron, 1971: 34.–Stephenson *et al.*, 1974: 114 (in part).–Poore *et al.*, 1975: 30. *Not* Monro, 1931: 28.
Pectinaria (Pectinaria) cf. *antipoda*.–Hartmann-Schröder, 1979: 145–146.
Cistenides antipoda Augener, 1927: 231–234.
Pectinaria sp 1.–Hutchings *et al.*, 1993: 10.

Type material. NEOTYPE: BMNH 1886.8.20.1, 22 mm long, 7.0 & 5.5 mm wide.

Type locality. New South Wales: Port Jackson, Sydney, 33°51'S 151°16'E.

Additional material examined. WESTERN AUSTRALIA: N. end of Oyster Harbour, 35°03'S 117°50'E, 21.vii.1963, 5.5 m, mud, 1, WAM 45-96*; 0.8 km SE of Mistaken I., King George Sound, 35°03'S 117°58'E, 21.vii.1963, 31.1 m, 1, WAM 47-96*; Bremmer Bay, 34°24'S 119°25'E, 13.i.1979, 1, WAM 31-96*; Albany, 35°0'S 117°52'E, 1, MV F78899; 3.2 km NW of Bussleton Jetty, 33°39'S 115°20'E, 12.iv.1963, 21.9–23.8 m, *Posidonia* and *Cymodosa* patches and sand, 6, WAM 42-96*; Gnarup Reef, Margaret River, 33°54'S 115°50'E, 3.ix.1987, sandy rockpool, 1, WAM 39-96*; Rottnest I., Pocillopora Reef, 32°00'S 115°30'E, 14.i.1991, 3 m, 4, AM W25406*; 3.2 km WNW of Cottesloe, 31°59'S 115°45'E, 5.v.1960, 7.3 m, 1, WAM 400-75*; Dampier Archipelago, Norbill Bay, Rosemary I., 20°29'S 116°35'E, 21.v.1972, 1.8–3.6 m, 2, WAM 354-75*; Mermaid Sound, 20°38'S 116°29'E, 10.ii.1981, 1, WAM 38-96*; lagoon between Trimoville and Alpha I., 20°24'31"S 115°32'33"E, 13.viii.1993, 3–5 m, silty grey sand, 1, WAM 34-96*; Broome, 18°58'S 122°14'E, 1, HZM P16615. QUEENSLAND: Heron I., Great Barrier Reef, 23°27'S 151°55'E, 29.viii.1984, 10 m, 1, AM W200622*; Dunwich, 27°30'S 153°24'E, 28.vi.1963, 1, QM G3600*; 2.4 km S of SW Rocks, Peel I., Moreton Bay, 27°30'S 153°21'E, December 1970, sand, shell, mud, 1, QM G10400*. NEW SOUTH WALES: Port Jackson, 33°51'S 151°16'E, 2, BMNH 1886.8.20.2–3; Sydney, E of Malabar, 33°50'S 151°17'E, 29.v.1973, 83 m, 2, AM W6462*; Port Hacking, Gunamatta Bay, 34°05'S 151°10'E, October 1957, muddy sand at LWM, 5, AM W3672*; Bass Point, 34°36'S 150°54'E, 29.x.1990, 65–70 m, 1, AM W25418*; Jervis Bay, Green Point, 35°01'00"S 150°45'12"E, 18.vi.1991, 12 m, 3, AM W25424*; Jervis Bay, Plantation Point (S), 35°04'48"S 150°41'48"E, 18.vi.1991, 20 m, 1, AM W25425*; Jervis Bay, Montagu Roadstead, 35°02'12"S 150°46'00"E, 5.vi.1990, 12 m, 2, AM W25428*; Jervis Bay, Hole in the Wall, 35°07'36"S 150°44'48"E, 18.vi.1991, 12 m, 1, AM W25426*; Jervis Bay, Honeymoon Bay, 35°03'48"S 150°45'24"E, 5.vi.1989, 20 m, 1, AM W25614*, 4, AM W21203*, 2, AM W25423*, 21.ii.1991, 2, AM W25420*, 21.viii.1989, 1, AM W25421*, 27.ii.1990; Eden, 37°04'S 149°55'E, 13.ix.1914, 9.1 m, 1, HZM V-9562*. VICTORIA: Port Phillip Bay, 38°21'S 144°51'30"E, 9.xii.1971, 9 m, 1, AM W16203*; SW of Sandringham, 37°58'S 144°59'E, 19.iv.1959, 2, MV F41676*; front of Popes Eye Beacon, 38°16'S 144°42'E, 28.ii.1982, 7 m, sand, 1, MV F78892*, 1, MV F41681; 2, MV F41676; off Werribee, 38°00'00"S 144°42'54"E, 19.xi.1971, 7 m, sand, 1, MV F78908*; Port Phillip Heads, 37°58'S 144°54'E, 1, BMNH 1885.11.19.79; W Bass Strait, 11 km SSW of Cape Otway, 38°58'18"S 143°29'12"E, 8.x.1980, 68 m, sand, 2, MV F78889*; 30 km S of Cape Otway, 39°06'48"S 143°37'36"E, 23.xi.1981, 92 m, sandy coarse shell, 2, MV F78891*; 47 km E of Cape Rochon, Three Hummock I., 40°23'48"S 145°32'E, 3.xi.1980, 66 m, mud-shell-sand, 1, MV F78920; 42 km SW of Babel I., 40°13'48"S 148°39'36"E, 60 m, muddy sand, 2, MV F78928; 94 km NE of North Point, Flinders I., 38°53'42"S 147°55'12"E, 17.xi.1981, 71 m, shelly sand, 2, MV F78929*; 46 km SW of Lakes Entrance, 38°17'S 147°29'E, 31.vii.1983, 29–31 m, 2, MV F78938*;

Table 3. Major distinguishing characters of species of *Lagis* (entries in parentheses are based on non-type material).

species	holotype length mm	holotype anterior width mm	cephalic veil, nos. of cirri	nos. of pairs of paleae	shape of paleae	opercular rim, nos. of cirri	posterodorsal lobe (segment 2)	anteroventral lobe (chaetiger 2)
L. abranchiata (Fauvel, 1932)	11, 12, 17—no holotype designated	3	15–20	15	stout, slender rolled-in tip; inner—shorter needle-like, ends bend towards each other	smooth	absent	smooth
L. australis (Ehlers, 1904)	9.5 (6–11)	3	20 (16–20)	10 (11–14)		smooth	absent	smooth or absent
L. bocki (Hessle, 1917)	27 (13–27)	*n.r.* (5)	40 (16–40)	12–15 (10–16)	curved dorsally, to a point (faintly serrated, coiled tips)	smooth, wide seam	*n.r.*	present, glandular
L. hupferi (Nilsson, 1928)	13–20	*n.r.*	8–11	13–15	wider, curved dorsally	high & thin	*n.r.*	glandular
L. koreni Malmgren, 1866	28 (14–50)	7 (5–9)	*n.r.* (13–30)	14 (8–17)	flat, acute apex (attenuated coiled tip; curved dorsally)	*n.r.* (smooth)	*n.r.* (absent)	*n.r.* (glandular; cirrate 8–10 lobed)
L. koreni cirrata (Day, 1963)	10	*n.r.*	14	10	curved dorsally	smooth & high	*n.r.*	absent
L. neapolitana (Claparède, 1868)	12–30 (25–32)	5–7 (9)	(12–25)	7–14 (7–12)	(curved dorsally, fine tip)	*n.r.* (smooth)	*n.r.* (absent)	glandular
L. pseudokoreni (Day, 1955)	16	4	10	11	golden-coloured	smooth	*n.r.*	glandular and ridged
L. tenera Hartmann-Schröder, 1959	2.5	*n.r.*	8–10	11	long, narrow, acute tip	smooth	absent	glandular

Table 3 (continued). Major distinguishing characters of species of *Lagis* (entries in parentheses are based on non-type material).

species	chaetigers on which notopodia reduced	nos. of rows of teeth per uncinus	nos. of teeth within a row on uncinus	scaphal shape	scaphe: anal flap	scaphal hooks: nos. of pairs & type	tube, shape & construction	glandular areas	type locality	additional records and comments*
L. abranchiata	1–3	4–5	6 (6–8?)	short, stout, erect edges bearing short ovate knobs	triangular, smooth edged, with small cirrus	10–12; short, stout, curved	straight, transparent quartz, very brittle, yellowish cement	absent on segment 4	Cochin, Ernakulam, India	(See below) [k]
L. australis	*n.r.*	3 (2–3)	4 (4–5)	longer than broad, lobed edges (oval)	poorly developed, with small cirrus	8	cone-shaped, sand grains	*n.r.* (strongly glandular)	Lyttelton, South Island, New Zealand	(See below) [l]
L. bocki	*n.r.*	4	7	oval, long, crenulated (recurved ventrally, crenulated)	longer than wide with long cirri (18–20 fimbriae plus small cirrus)	4 (3–4), claw-hook like	*n.r.* (sand grains)	*n.r.* (strongly glandular)	Kobe Bay, Japan, 14 m	(See below) [m]
L. hupferi	*n.r.*	3	5–6	wide oval, crenulate/lobed margin	crenulate margin, semi-circular, lacking anal cirrus	7	curved, sand grains	strongly glandular	Cameroon, SW coast of Africa	Known only from original description. Notochaetae with finely serrated tips.
L koreni	*n.r.* (1–3)	*n.r.* (3–4)	*n.r.* (6–8)	*n.r.* (long oval, lobed margins)	*n.r.* (longer than broad with small cirrus)	*n.r.* (2–7)	slightly curved (sand)	*n.r.* (strongly glandular)	Stavanger, Finnmark, Norway—Lectotype assigned by Nielsen *et al.* (1977)	(See below) [n]
L. koreni cirrata	1–3	2	6–7	oval, lobed margin	tongue shaped with small anal cirrus	4–6	coarse sand grains	*n.r.*	off Natal, South Africa	Known only from original description, based on single specimen.
L. neapolitana	(1–3)	*n.r.* (2–3)	7–8 (5–8)	wide oval with lobed margin	semi-circular with small cirrus	6 (4–8)	*n.r.* (curved, irregular grains)	*n.r.* (strongly glandular)	Gulf of Naples, Mediterranean	(See below) [o]
L. pseudokoreni	1–3	2–3	6–8	long oval with crenulated margin	triangular with small anal cirrus	5	sand	*n.r.*	Knysna Estuary, South Africa	Known only from original description, based on single specimen.
L. tenera	1–3	3–4	7	long oval, lobed margins	semi-circular with large anal cirrus	3	*n.r.*	strongly glandular	La Herradura, Estero Jaltepeque, El Salvador	Known only from original description, based on single specimen.

n.r. character not recorded.

* Only a selection of records are given based on the literature to indicate distribution of species, however distributions outside the region of the type locality require verification.

[k] [*abranchiata*] Re-recorded from India (Fauvel, 1953). Notochaetae narrow winged some straight with spinous tips. Characterised by absence of branchiae.

[l] [*australis*] Additional records from New Zealand (Augener, 1926). (Redescribed by Nilsson, 1928). (Examined material from type locality). Notochaetae with finely serrated tips.

[m] [*bocki*] Recorded by Nilsson, 1928 & Imajima & Hartman (1964) Annenkova (1929) described a variety of this species.

[n] [*koreni*] Recorded from Bering Sea (Annenkova, 1929); Swedish west coast (Hessle, 1917; Nilsson, 1928); North Sea, English Channel, Atlantic Ocean, Mediterranean, Adriatic (Fauvel, 1927; Holthe, 1986).

[o] [*neapolitana*] Records: Mediterranean Sea (Hessle, 1917; Nilsson, 1928); Black Sea (Annenkova, 1929); southwest Africa (Day, 1967).

Table 4. Major distinguishing characters of species of *Pectinaria* (entries in parentheses are based on non-type material)

species	holotype length mm	holotype anterior width mm	cephalic veil, nos. of cirri	nos. of pairs of paleae	shape of paleae	opercular rim, nos. of cirri	posterodorsal lobe (segment 2)	anteroventral lobe (chaetiger 2)
P. aegyptia (Savigny, 1818)	(70, 65)	(17, 15)	(65, 60)	(16–17, 15)	(narrow, elongate, curved spiral-form tip)	(*n.r.*)	(*n.r.*)	(present?)
P. antipoda Schmarda, 1861	22 (7–74)	5 (2–12)	present (17–29)	8 (5–6; 10–13)	subacute–acute (curved dorsally)	*n.r.* (smooth, well developed)	*n.r.* (absent)	*n.r.* (present, 12–19 cirri)
P. belgica (Pallas, 1766) sensu Malmgren, 1866	(30–70)	(9–12.5)	(17–28)	(8–15)	(attenuated, spiral-form tip)	(wide and smooth)	(absent)	(glandular)
P. brevispinis Grube, 1878	92 (60–90)	10 (12–17)	25–30 (22–24)	12–13 (10)	*n.r.* (short, subacute)	smooth (a little wrinkled)	absent	absent (slightly glandular)
P. californiensis Hartman, 1941	19	*n.r.*	18–30	*n.r.*	flattened, tapering to fine attenuate, recurved tips	*n.r.*	*n.r.*	*n.r.*
P. c. newportensis Hartman, 1941	*n.r.*	*n.r.*	19	9–13	slender, flattened, fine coiled tips	*n.r.*	*n.r.*	*n.r.*
P. clava Grube, 1878	17	6.5	10 (10–12)	11	acute, curved	smooth (wrinkled)	absent	*n.r.* (absent)
P. chilensis (Nilsson, 1928)	60 (46)	12 (15)	60 (30–60)	8–9 (9–10)	wide (elongate, attenuate)	smooth, low rim	*n.r.*	glandular?
P. conchilega Grube, 1878	32	5.5	12	11	acute curved	smooth	absent	*n.r.*
P. dimai Zachs, 1933	*n.r.*	*n.r.*	*n.r.*	*n.r.*	*n.r.*	*n.r.*	*n.r.*	*n.r.*
P. dodeka n.sp.	17 (8–80)	4 (18)	16 (16–28)	12 (11–13)	subacute, curved dorsally	smooth, well developed	absent	smooth, glandular
P. gouldii (Verrill, 1874)	40 (12–45)	7 (1–9)	28 (12–38)	15 (9–15)	curved upward, long slender, acute tip (tapering to fine, slightly curved tips)	smooth	*n.r.*	*n.r.* (glandular)
P. hartmanae Reish, 1968	15–20	3–4	30	8–10	flattened, recurved, attenuated tips	*n.r.*	*n.r.*	*n.r.*
P. kanabinos n.sp.	14 (10–24)	3 (1–5)	15 (10–16)	14 (12)	acute, needle-like	smooth, well developed	absent	smooth, glandular
P. longispinis Grube, 1878	18.5	2	17	13	curled tips	smooth	absent	*n.r.*
P. meredithi Long, 1973	26 (9–26)	4 (2–4)	21 (16–21)	10 (8–11)	fine, slightly curved tips	smooth	*n.r.*	glandular
P. nana Wesenberg-Lund, 1949	5	*n.r.*	8	11	broad flat, evenly tapering	smooth	absent	smooth, reduced
P. panava Willey, 1905	*n.r.*	*n.r.*	32	10	*n.r.*	*n.r.*	*n.r.*	glandular
P. papillosa Caullery, 1944	*n.r.* (60)	*n.r.* (16–20)	24 (46)	11 (13)	fine tips	smooth	*n.r.* (absent)	glandular (cirrate)
P. parvibranchis Grube, 1878	13.8 (14)	1.8 (4)	12–13	10–11	curved, acute tips	smooth	absent	*n.r.*
P. profunda Caullery, 1944	*n.r.*	*n.r.*	20	12	fine tip, flexible and recurved	smooth	*n.r.*	glandular
P. regalis (Verrill, 1901)	95 (26–90)	12–13 (6–17)	(21–35)	11–13 (8–14)	acute (stout, slightly curved tips)	smooth	absent	cirrate (glandular)

Table 4 (continued). Major distinguishing characters of species of *Pectinaria* (entries in parentheses are based on non-type material)

species	chaetigers on which notopodia reduced	no. of rows of teeth per uncinus	no. of teeth within a row on uncinus	scaphal shape	scaphe: anal flap	scaphal hooks: nos. of pairs & type	tube, shape & construction	glandular areas	type locality	additional records and comments*
P. aegyptia	(*n.r.*)	(2)	(8, 7–8)	(oval, with 4 large lobes)	(strongly grooved edges, with poorly developed cirrus)	(4–5, stout with strongly curved tips)	(straight sided, wide, fragments)	(triangular lobe present, a number of patches, strongly glandular)	Gulf of Suez?	(See next page) [p]
P. antipoda	1–3 (15–17)	*n.r.* (2–4)	8 (6–10)	diamond shaped (oval shaped, as long as wide, lobed edges)	*n.r.* (triangular, with small anal cirrus)	*n.r.* (6–8)	clear grains, clear cement (pale grains of shell)	*n.r.* (strongly glandular)	Port Jackson, Australia. Type lost, neotype designated this paper.	(See next page) [q]
P. belgica	1–3	2–3–4	7–8	oval, long, crenulated edges	small; wider than long, with short cirrus	6–12	straight, sand grains, brown	strongly glandular	Bohuslan, Sweden. Neotype designated by Nielsen et al., (1977) from Malmgren's material.	(See next page) [r]
P. brevispinis	1–3	*n.r.* (2)	9 (7–9)	oval, crenulated (broader than wide)	reduced	10 (8–12), 14 long, with pointed tips	curved (long & wide)	glandular	Philippines	Recorded from Philippines (Nils--son, 1927); Indonesia (Caullery, 1944).
P. californiensis	1–3	2	5	as long as broad, crenulated margin	wide as long with small cirrus	13	reddish sand grains	*n.r.*	Southern California, intertidal, USA	Hartman (1941) records species widely from S. California, USA.
P. c. newportensis	1–3	2	5	as long as broad, crenulated margins	margins with 16 clavate papillae with large cirrus	10–12	sand grains	strongly glandular	Newport Bay, California, USA	(See next page) [s]
P. chilensis	1–3	2	7–8	longer than wide, lobed edges	long with anal cirrus (crenulate margin)	15 (13–15)	*n.r.* (straight, greyish)	strongly glandular	Coronel, Chile	Recorded from Independencia Bay, Peru (Hartman, 1941).
P. clava	*n.r.*	*n.r.* (3)	6–7 (5–6)	oval, long	*n.r.*	6	fragile, dark	*n.r.*	Lapinig Canal,Philippines	Recorded from by Nilsson, 1928 (Philippines).
P. conchilega	1–3	*n.r.* (3–4)	6–7 (5–6)	short, sub-oval, lobed (wide oval, lobed edges)	small (crenulate margin, no anal cirrus)	*n.r.* (4)	(curved, sand grains)	*n.r.*	Bohol, Philippines	Recorded from Philippines by Nilsson (1928) who re-examined type material.
P. dimai	*n.r.*	3–4	6–7	*n.r.*	*n.r.*	*n.r.*	*n.r.*	*n.r.*	North Japan Sea	Known only from original record; original description poor.
P. dodeka n.sp.	1–3, 15–17	2–4	6–10	broader than long, lobed crenulated margin	present	8 (6–10) broad, blunt, brown	pale grains of sand, and shell	strongly glandular	Dunwich, Moreton Bay, Queensland, Australia	See Fig. 10 for distribution.
P. gouldii	*n.r.* (1–3, 16)	*n.r.* (2–4)	*n.r.* (6–8)	*n.r.* (wide, oval, lobed margins)	*n.r.* (semi-circular with small cirrus)	17–22 (8–16, size dependent)	*n.r.* (clear grains, curved; tapered)	*n.r.* (strongly glandular)	syntype from Long Island Sound USA (*fide* Long, 1973)	(See next page) [u]
P. hartmanae	1–3	2	7	*n.r.*	crenulated margin, medial cirrus	8–10, blunt, brassy	straight, coarse silicious grains	*n.r.*	Bahia de los Angeles, Baja California, USA	Known only from type series.
P. kanabinos n.sp	1–3, 15–17	2–4	6–10	longer than broad, crenulated margin	damaged	5 (4–6) fine, small,	*n.r.*	Weakly glandular	Calliope River Gladstone, Queensland, Australia	See Fig. 10 for distribution.
P. longispinis	*n.r.*	*n.r.*	7	rounded quadrate	*n.r.*	4	granular	*n.r.*	Philippines	Known only from original record.
P. meredithi	1–3, 16	2–3	6–8	long oval, lobed margins	semi-circular with small cirrus	8 (7–9)	slightly curved, 2 layers	*n.r.*	Bahamas	Recorded from Florida Keys, USA (Long, 1973).
P. nana	1–3	*n.r.*	*n.r.*	oval with highly lobed margins	longer than wide with long anal cirrus	3	straight, silicious grains	*n.r.*	Gulf of Oman, Iran	Known only from a single specimen.
P. panava	1–3	*n.r.*	8	acetabuliform	semi-lunar	7	*n.r.*	*n.r.*	Sri Lanka	"The characters given are not even sufficient for generic identification" (Fauvel, 1953).
P. papillosa	1–3, 17	2	9 (7–8)	oval, lobed margins, papillose surface	ligule triangular without anal cirrus	11 (3–4)	brown, forams (sand grains)	*n.r.*	Indonesia (5°28'S 134°53'E) 47 m.	Recorded from Inhaca Island, Delagoa Bay, Mozambique (Day, 1951).
P. parvibranchis	*n.r.*	*n.r.* (3–4)	7 (6)	trapezoidal	*n.r.*	4	curved	*n.r.*	Pangloo, Philippines	Redescribed by Nilsson (1928) from the Philippines.
P. profunda	1–3, 17	2	6	lobed margins, wide oval	triangular with small cirrus	present but not counted	*n.r.*	*n.r.*	Indonesia (5°40'S 132°26'E)	Known only from two individuals.
P. regalis	1–3, 16	*n.r.* (2–3)	*n.r.* (6–10)	semi-circular, lobed margin	*n.r.*	*n.r.* (1–4)	curved, pale, sand (blunt, shell, forams)	*n.r.*	Cony Island, Bermuda	(See next page) [v]

Table 4 (footnotes).

n.r. character not recorded.
* Only a selection of records are given based on the literature to indicate distribution of species, however distributions outside the region of the type locality require verification.
p [*aegyptia*] Recorded from Red Sea, Mozambique, Japan? (Nilsson, 1928; Imajima & Hartman, 1964; Marenzeller, 1879; Grube, 1870; Gravier, 1906).
q [*antipoda*] Recorded from New Zealand (Ehlers, 1904), SE Australia (Nilsson, 1927; Augener, 1927); Gulf of Oman (Wesenberg-Lund, 1949); Persian Gulf (Fauvel, 1953); Broome, WA (Hartmann-Schröder, 1979). Non-Australian material needs checking.
r [*belgica*] Recorded from: Swedish west coast (Hessle, 1917); North Sea; Irish Sea; Atlantic Coast of West Ireland (Fauvel, 1927); Boreal Atlantic Ocean (Nilsson, 1927); North Sea, Scandinavia (Holthe, 1986).
s [*californiensis newportensis*] Known only from original record, differs from stem species in shape and colour of paleae and shape of scaphal hooks.
u [*gouldii*] Recorded as *P. belgica* on East coast of USA and West Indies (Gould, 1841; Nilsson, 1928; Long, 1973).
v [*regalis*] Recorded from Bermuda, Puerto Rico, Virgin Islands, Barbados, Florida, Bonaire, Georgia (Long, 1973).

Bennison Channel, 1 km S of Granite I., 38°49'S 146°23'E, 23.xi.1983, 6 m, sand, shell, grit, 1, MV F78901*. Tasmania: Midway Point, 42°48'S 147°32'E, 9.xii.1973, 1, TMAG K937*; Tasman Peninsula, Fortescue Bay, 43°08'S 147°57'E, 7.vi.1977, 10 m, sand, 1, TMAG K935*; Tasman Peninsula, Koonya, 43°04'S 147°49'E, 26.v.1974, muddy sand, 1, TMAG K432*; Tinderbox, 43°04'S 147°20'E, 18.iii.99, 8 m, 1, AM W26160*; North East River, 39°45'S 147°56'E, 8.iv.97, low water mark, 1, AM W26161*; Dennes Point, 43°05'S 147°21'E, 28.iii.99, 5 m, 2, AM W26162*; Creeses Mistake, 43°07'S 147°47'E, 30.iv.99, 15.5 m, 3, AM W26163*; Simmonds Point, 43°12'S 147°17'E, 29.i.99, 17.9 m, 2, AM W26164*. SOUTH AUSTRALIA: Nuyts Archipelago, Franklin I., N of West I., 32°27'S 133°40'E, 14.iv.1983, 6–8 m, sandy seagrass beds, 1, SAM E3042*; Sir Joseph Banks Group, W side of Kirkby I., 34°33'S 136°13'E, 31.i.1986, 3–10.7 m, reef rubble, sand and *Posidonia*, 8, SAM E3076*; E of Lusby Rocks, between Lusby and Partney I., 34°32'S 136°15'30"E, 24.i.1986, 3–4.6 m, reef, rubble, sand and *Posidonia*, 3, SAM E3088*; cove at S end of Reevesby I., 34°32'S 136°17'E, 24.i.1986, 3–6.1 m, reef, deep crevices and sand pockets, 1, SAM E3086*; Kangaroo I., Bay of Shoals, 35°50'S 137°15'E, March 1978, 33 m, 1, AM W25409*; Kangaroo I., N side of Point Ellen, 36°00'S 137°11'E, 26.i.1989, 2.4–7.6 m, sand, 1, SAM E3087*; Yorke Peninsula, Wool Bay Jetty, 35°00'S 137°46'E, 3.i.1994, 3 m, sand, 3, SAM E3083*; Spencer Gulf, Yorke Peninsula, Point Turton Jetty, 34°56'S 137°21'E, 25.xi.1985, 3–4.6 m, sand and rubble, 1, SAM E3035*; Eyre Peninsula, Fancy Point, Boston I., 34°39'S 136°54'E, 17.ii.1988, 1.5–8 m, in amongst kelp, *Posidonia* seagrass, sand, 1, SAM E3077*; Edithburgh, 35°05'S 137°45'E, 27.x.1980, 3 m, in sand amongst rocks, 1, SAM E3089*; Spencer Gulf, 16 km SW of First Creek, Port Pirie, 33°16'S 137°51'E, 1979, 12.1 m, 1, AM W25410; Monument Hill, 32°50'S 137°49'E, September 1987, 17 m, 1, SAM E3066*; Whyalla, 33°05'S 137°37'38"E, August 1986, 12 m, sand, 1, SAM E3050*; Victor Harbour, the Bluff, 35°33'S 138°38'E, 8.xi.1980, under sand on rock, 1, SAM E3092*; Cape Jervis Jetty, 35°36'S 138°06'E, 9.iii.1984, 3 m, sand in amongst rocks, 1, SAM E3081*; N of St. Francis I., 32°31'S 133°18'E, 30.xii.1975, 20–30 m, 1, MV F78893*. Material examined 7 to 74 mm long & 2 to 12 and 1 to 6 mm wide. A selection of material examined listed, although all material examined has been incorporated into Fig. 13, illustrating the distribution and abundance of the species.

Material described. Neotype.

Description. Preserved specimen grey to pale cream in colour. Body small, conical in shape. Tube curved, composed of cemented shell-like fragments, or composed of sand grains. Rim of cephalic veil with 17 long cirri. Cirri are triangular appendages, which rapidly taper (Fig. 9A). Cephalic veil completely free from operculum, forming a dorsal semi-circle around the numerous buccal antennae.

Raised opercular margin well developed, smooth. Operculum with 10 pairs of paleae, yellow-gold, subacute, curved dorsally, long without extended tips. First pair of tentacular cirri arise from anterior edge of segment 2. Ventral ridge connecting second pair of tentacular cirri on segment 3 incised to form glandular lobes. Segment 2 lacking posterodorsal lobe. Chaetiger 2 with anteroventral lobe large and broad; anterior margin of lobe with 13 contiguous rounded papillae.

Two pairs of comb-like, stalked branchiae on segments 3 and 4, situated laterally and consisting of loose flat lamellae. Anterior pair situated more ventrally than posterior pair, both pairs similar in size, lying flattened against the body.

Chaetigers 1 to 3 (segments 5 to 7) with notopodia and notochaetae only. Chaetigers 4 to 16 biramous with both notopodia, neuropodia, and notochaetae and neurochaetae. Chaetiger 17 with only notopodia and notochaetae. Notochaetae from chaetiger 5 include smooth winged capillaries, and capillaries with finely serrated margins (Figs. 10A). Notochaetae from chaetiger 14 with finely hirsute surfaces. Notochaetae of chaetigers 1–3 and 15–17 reduced in size compared to those of notopodia 4–14. Neuropodia wedge shaped, erect and glandular. Neurochaetae with major teeth arranged in two rows, 6–10 teeth per row (Figs. 10B,C, 12A).

Posterior scaphe and abdomen distinctly separated. Posterior 5 segments fused to form a flattened plate or scaphe longer than broad, with crenulated margins (Fig. 9B). Anal flap present with dorsal papilla. Scaphal hooks present, 7 pairs, broad, blunt, brown (Fig. 12B). Glandular areas present on chaetigers 4 to 17, prominent, ventrally glandular on segments 1–6.

Nephridial papillae present on segments 3 and 4, inserted ventrally at base of branchiae.

Variation. The number of cirri on the cephalic veil margin varies from 19 to 29, and the number of papillae on the anteroventral lobe of chaetiger 2 ranges from 12 to 19. The size of the anterior pair of branchiae varies such that on some specimens they are larger than the posterior pair. The number of scaphal hooks varies from 6 to 8 pairs. The development of the glandular areas varies between specimens. Most of these variations appear to be size dependent, with larger animals having more cirri, papillae and pairs of scaphal hooks than smaller individuals.

Remarks. Schmarda's type of *P. antipoda* could not be located. Most of Schmarda's material is housed in the Naturhistorisches Museum in Vienna. Dr Helmut Sattmann, the Curator of polychaetes at this Museum, confirmed that no material of *P. antipoda* was present in their collections. The species has been reported from Australia several times since it was described in 1861, by Augener (1927), Knox & Cameron (1971) and Poore *et al.* (1975). All this material has been examined and represents *P. antipoda*. Nilsson

Figure 9. *Pectinaria antipoda* (Schmarda, 1861). Neotype (BMNH 1886.8.20.1). A, lateral view of anterior end. B, lateral view of posterior end. Scales = 2 mm.

(1928) also described the species and examined some material from Port Phillip Bay housed in the Zoologisches Museum, Museum für Naturkunde der Humboldt-Universität, Berlin. According to Dr Neuhaus, the Curator responsible for polychaetes, the material has been lost, perhaps destroyed during the Second World War. As *P. antipoda* is widely distributed throughout Australian waters, the species needed to be fully described because the original description is brief. Three specimens of *Pectinaria antipoda* were found in the Natural History Museum in London. They were collected by Dr Robert von Lendenfeld, an Austrian sponge worker who visited Australia in the 1880s, and although he established a laboratory in Melbourne on the shores of Port Phillip Bay, he also travelled to Sydney. These three specimens were collected from Port Jackson several decades after Schmarda's material was collected, although no detailed location within the harbour is given. During this period, little development occurred within the harbour, so we have assumed that environmental conditions were similar to those at the time Schmarda's material was collected. Another species of this genus, *Pectinaria dodeka* n.sp. (described in this paper), is also present in Sydney Harbour, but the material of Lendenfeld most closely resembles Augener's material and that described by Nilsson and the brief description given by Schmarda (1861). To stabilise the name, we have designated a neotype of *Pectinaria antipoda* from among these three specimens, provided a full description and re-illustrated the species.

The distribution of the two species of *Pectinaria* in Sydney Harbour is not known. The harbour has a variety of habitats and the two species were never present in the same samples examined by us.

Pectinaria antipoda can be distinguished from the other two species of *Pectinaria* present in Australian waters, *P. dodeka* n.sp. and *P. kanabinos* n.sp., both described in this paper, by the presence on the anteroventral lobe of chaetiger 2, ornamented with 12–19 papillae, which are absent in the other two Australian species. Only one other described species of *Pectinaria, P. papillosa* Caullery, 1944, has such papillae (Table 4).

Material identified by Monro (1931) from Low Islands, Great Barrier Reef (BMNH 1931.7.1.61) as *P. antipoda* Schmarda, 1861, was re-examined and identified as *P. dodeka* n.sp. (this paper). Material identified as *P. antipoda* by Stephenson *et al.* (1974) from Moreton Bay was re-examined and consisted of both *P. antipoda* and *P. dodeka* n.sp. Material identified by Hartmann-Schröder (1979) as *P.* cf. *antipoda* has been re-examined and although the material is in poor condition, especially in the region of

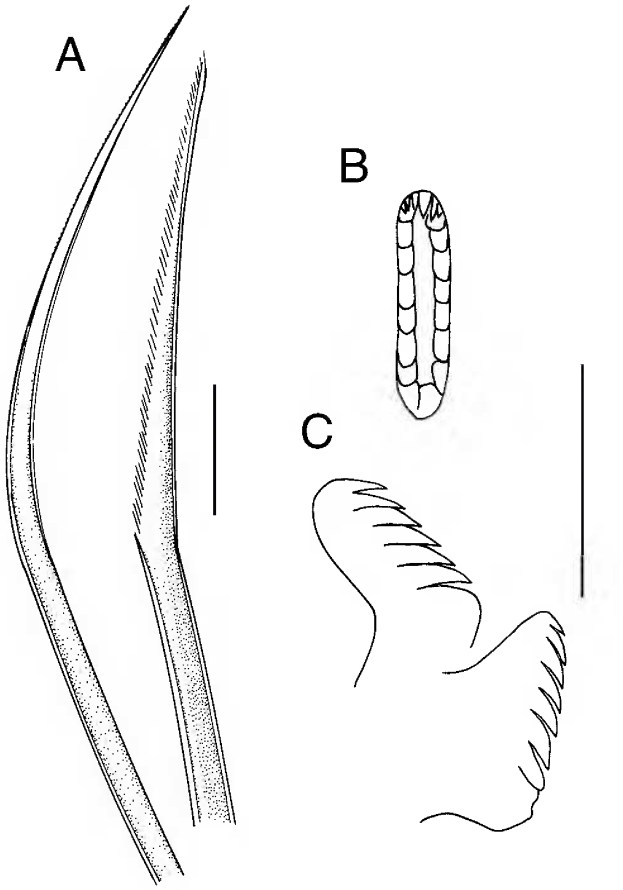

Figure 10. *Pectinaria antipoda* (Schmarda, 1861). Neotype (BMNH 1886.8.20.1). A, two types of notochaetae from chaetiger 5. B, frontal view of neurochaeta from 6th uncinigerous segment. C, lateral view of two neurochaetae from 6th uncinigerous segment. Scales = 100 μm.

chaetiger 2, we believe that it is *P. antipoda*.

Distribution. Widely distributed south from Broome, Western Australia around southern Australia and along the eastern coast to Heron Island, Queensland (Fig. 13).

Habitat. Recorded from low water mark to 92 m, in sediments ranging from mud, silty sand to sand, and occasionally in *Posidonia* seagrass beds.

Pectinaria dodeka n.sp.

Figs. 11A–B, 12C–D, 13, 14A–B, 15A–C, Tables 4, 6

Pectinaria brevispinis.–Nilsson, 1928: 64–68.–Monro, 1931: 27–28.–Caullery, 1944: 71. *Not* Grube, 1878.

Pectinaria antipoda.–Stephenson *et al.*, 1974: 114 (in part). *Not* Schmarda, 1861.

Type material. HOLOTYPE: 1, AM W25615*, 27.iii.1962, 17 mm long, 4 & 2 mm wide. PARATYPE: 1, AM W19076*, 21 mm long, 4 & 2 mm wide.

Type locality. Queensland: Moreton Bay, Dunwich, 27°30'S 153°24'E, collected 27.iii.1962, no information on habitat available.

Additional material examined. NORTHERN TERRITORY: Darwin Harbour, 12°27'S 130°48'E, 6.vii.1993, 17 m, 1, NTM W10399*; Gulf of Carpentaria, Bing Bong, McArthur River, 15°37'S 136°15'E, 2, NTM W7720*; 1, NTM W16862*; 1, NTM W16864*. QUEENSLAND: Torres Strait, Murray I., 09°33'S 144°03'E, 1, AM W2648*; Low Isles, Great Barrier Reef, 16°23'S 145°34'E, ii.1929, 1, BMNH 1931.7.1.60, ii.1929, 1, BMNH 1931.7.1.61, February 1929; 1, AM W2615*; off South Mission Beach, Dunk I., 17°57'S 146°09'E, ii.1910, 1, AM W100*; Whitsunday Group, 20°03'S 148°53'E, i.1933, 1, AM W3028; Lindeman I., 20°27'S 149°02'E, 1935, 1, AM W25446*, in sand*, i.1928, 16 m, 1, AM W2649*; Hayman I., Whitsunday Pass, 20°03'S 148°53'E, i.1934, 1, AM W3117*; Langford Reef, Black I., 20°05'S 148°54'E, xi.1969, 1, AM W4292; Calliope River, N of Gladstone, 24°01'S 150°59'E, 1974, 4, AM W199312*; Moreton Bay, Dunwich, 27°25'S 153°20'E, 1967, 1, QM G5042*; Stradbroke I., Dunwich, 27°30'S 153°24'E, 4.x.1952, 1, QM G4080*; 2.4 km S of South West Rocks, Peel I., 27°30'S 153°21'E, vi.1970, 3.4 m, sand, mud, shell, 1, QM G10340*; Brisbane River mouth, 27°22'S 153°11'E, 22.vii.1975, sand and mud, 3, QM GH2880*; Middle Banks, 27°13'S 153°19'E, viii 1982, 4, QM G212177*; 1.6 km SE of Redcliffe Jetty, 27°15'S 153°08'E, 15.xii.1964, 4.2 m, shell, grit, 1, QM G5040*; Bramble Bay, 27°18'S 153°06'E, 29.vi.1972, 4, QM G10515; viii.1972, 2, QM G10635*; NEW SOUTH WALES: Lake Macquarie, 36°54'S 149°53'E, vi.1977, *Zostera* beds, 2, AM W17847*; Sydney, Port Jackson, 33°50'S 151°16'E, xi.1925, 1, AM W1760*; between Sow & Pigs Shoal and Shark I., 30°52'S 153°00'E, iv.1928, 4–5 m, 1, AM W2578*; 1 km SE of Little Bay, Malabar, 33°59'09"S 151°15'40.2"E, 12.v.1972, 25 m, 1, AM W6460*; SE of Malabar, 33°58'7.8"S 151°16'52.2"E, 2.i.1973, 49–53 m, 1, AM W6461*; Jervis Bay, 35°03'S 150°44'E, 23.iv.1973, 15 m, sand, 1, AM W5617*; Merimbula Channel, 36°55'S 149°55'E, 4.xii.1975, *Posidonia*, on south side of seaward end of central sand bank, 1, AM W17111*; Lake Merimbula, 36°03'S 151°36'30"E, 25.xi.1977, 6 m, mud, 1, AM W19254*; 900 m SW of Narooma Bridge, Wagonga, 36°13'42"S 150°07'30"E, weed beds, 1, AM W10498*. VICTORIA: central Bass Strait, 35 km NNE of Cape Wickham, 39°16'00"S 144°05'24"E, 23.xi.1981, 82 m, sandy shell, 2, MV F78890*. Material examined varied from 8 to 80 mm long & 2 to18 & 1 to 8 mm wide.

Description. Preserved specimen small, conical-shaped, grey to pale cream in colour, and some black pigmentation present anteriorly. Tube curved, composed of cemented shell-like fragments.

Rim of cephalic veil with 16 long cirri tapering to blunt tip. Cephalic veil completely free from operculum forming dorsal semi-circle around numerous peristomial palps.

Raised opercular margin well developed and smooth. Operculum with 12 pairs of paleae, long, golden brown, subacute, curved dorsally, with compact tips. First pair of tentacular cirri arising from anterior edge of segment 2. Ventral ridge connecting second pair of tentacular cirri on segment 3 incised, forming glandular lobes. Chaetiger 2 with anteroventral lobe large and broad; anterior margin of lobe crenulate, posterodorsal lobe absent (Fig. 14A).

Two pairs of comb-like stalked branchiae, consisting of loose, flat lamellae. Anterior pair situated more ventrally than posterior pair and larger than posterior pair. Branchiae lie flattened against body on preserved animals.

Chaetigers 1 to 3 (segments 5 to 7) with notopodia and notochaetae only. Chaetigers 4 to 16 with notopodia, neuropodia, notochaetae and neurochaetae. Chaetiger 17 with notopodia and notochaetae only. Notochaetae capillaries with one margin strongly pectinated (Figs. 11A–B, 15A). Notopodia and notochaetae of chaetigers 1 to 3 and 15 to 18 are slightly reduced in size in comparison to

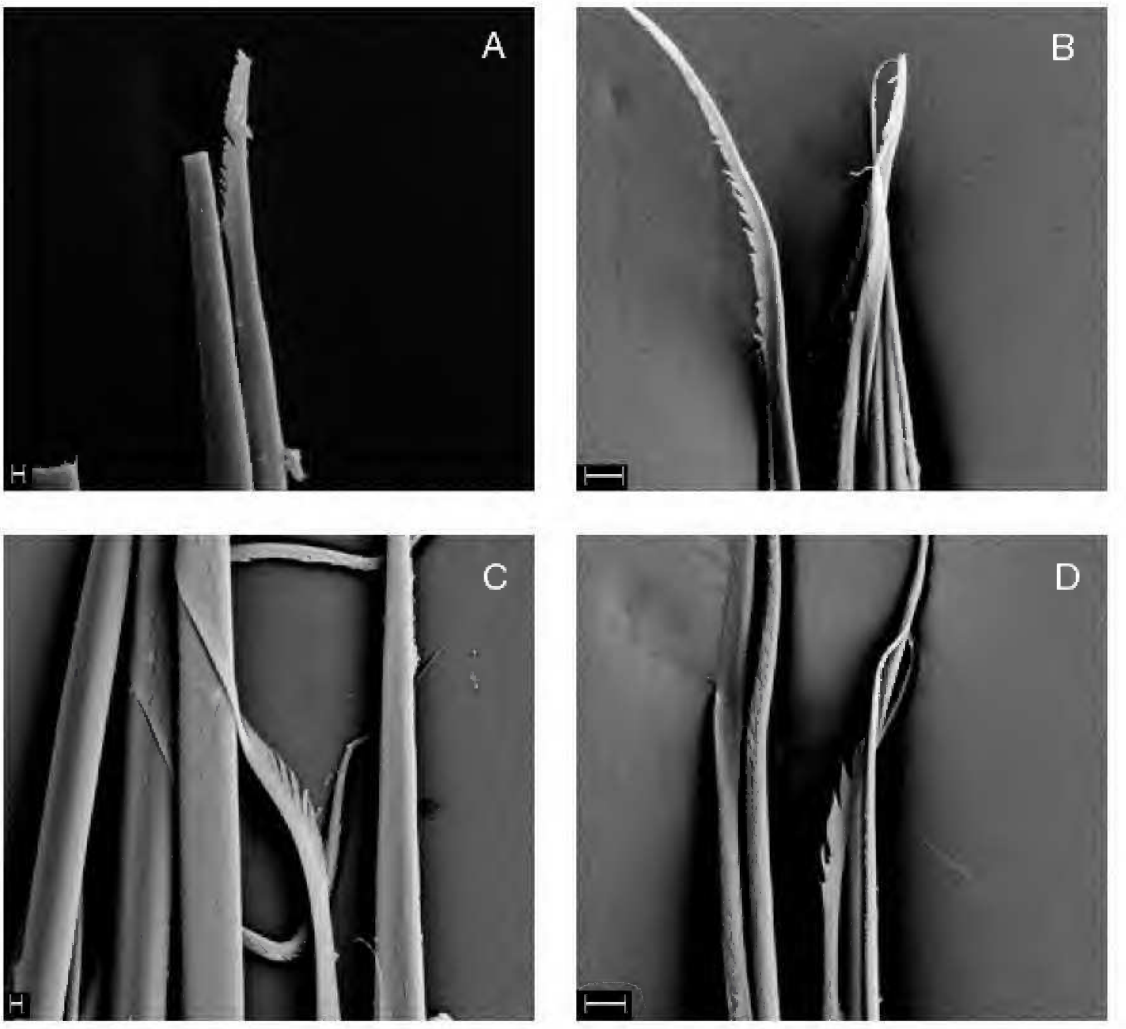

Figure 11. A, *Pectinaria dodeka* n.sp. notochaetae from chaetiger 4, scale = 3 μm. B, *Pectinaria dodeka* n.sp. notochaetae from chaetiger 14, scale = 10 μm. C, *Pectinaria kanabinos* n.sp. notochaetae from chaetiger 4, scale = 3 μm. D, *Pectinaria kanabinos* n.sp. notochaetae from chaetiger 14, scale = 10 μm.

those of chaetigers 4 to 14. Neuropodia wedge shaped, erect with margins becoming rounded posteriorly, glandular. Neurochaetae with major teeth arranged in two rows, 6–10 teeth per row (Figs. 12C, 15B–C).

Posterior scaphe and abdomen distinctly separated. Posterior 5 segments fused to form a flattened plate or scaphe broader than long, with crenulated margins. Scaphe with an anal flap and dorsal papilla. Eight pairs of scaphal hooks, broad, blunt, brown (Fig. 12D). Prominent glandular areas present on chaetigers 4 to 17, and ventral areas of segments 1 to 6 also glandular. Triangular gland present between segments 2 and 3, situated mid-ventrally. Segments 3 and 4 with raised glandular anterior margins extending across venter. Paired nephridial papillae on chaetiger 1, inserted ventrally at the base of the second pair of branchiae.

Variation. The number of cirri on the cephalic veil margin varies from 16 to 28, the number of pairs of paleae varies from 11–13, and the number of scaphal hooks varies from 6 to 10 pairs, and this appears to be related to size with larger animals having more cirri, paleae and hooks than smaller individuals. The anterior pair of branchiae in some specimens are of similar size to the posterior pair. The intensity of the glandular areas varies.

Remarks. *Pectinaria dodeka* n.sp. can be distinguished from all other described species of *Pectinaria* by the following combination of characters: 16–18 pairs of cirri on the cephalic veil, 11 to 13 pairs of subacute dorsally curved paleae and 6–10 pairs of scaphal hooks (see Table 4). The species most closely resembles another Australian species, *P. kanabinos*, in terms of the number of cephalic cirri present, but can be distinguished from it by the shape of the paleae: subacute curved dorsally in *P. dodeka* and acute needle shaped in *P. kanabinos*. In addition, the shape of the scaphe and the number of pairs of scaphal hooks differs between the two species. The species may be separated from *P. antipoda* by the lack of rounded papillae on the anterior margin of the anteroventral lobe of chaetiger 2. Many other species have a similar number of paleae, although as is clear from Table 4, some species exhibit a considerable range in the number of pairs present; this may be a function of size of individuals or perhaps an indication that the paleae can be replaced if damaged during feeding. The absolute number of pairs of paleae may not be a useful character.

Material identified as *P. brevispinis* by Monro (1931) (BMNH 1931.7.1.61; 1931.7.60.) from Low Isles, Queensland has been re-examined and we have referred

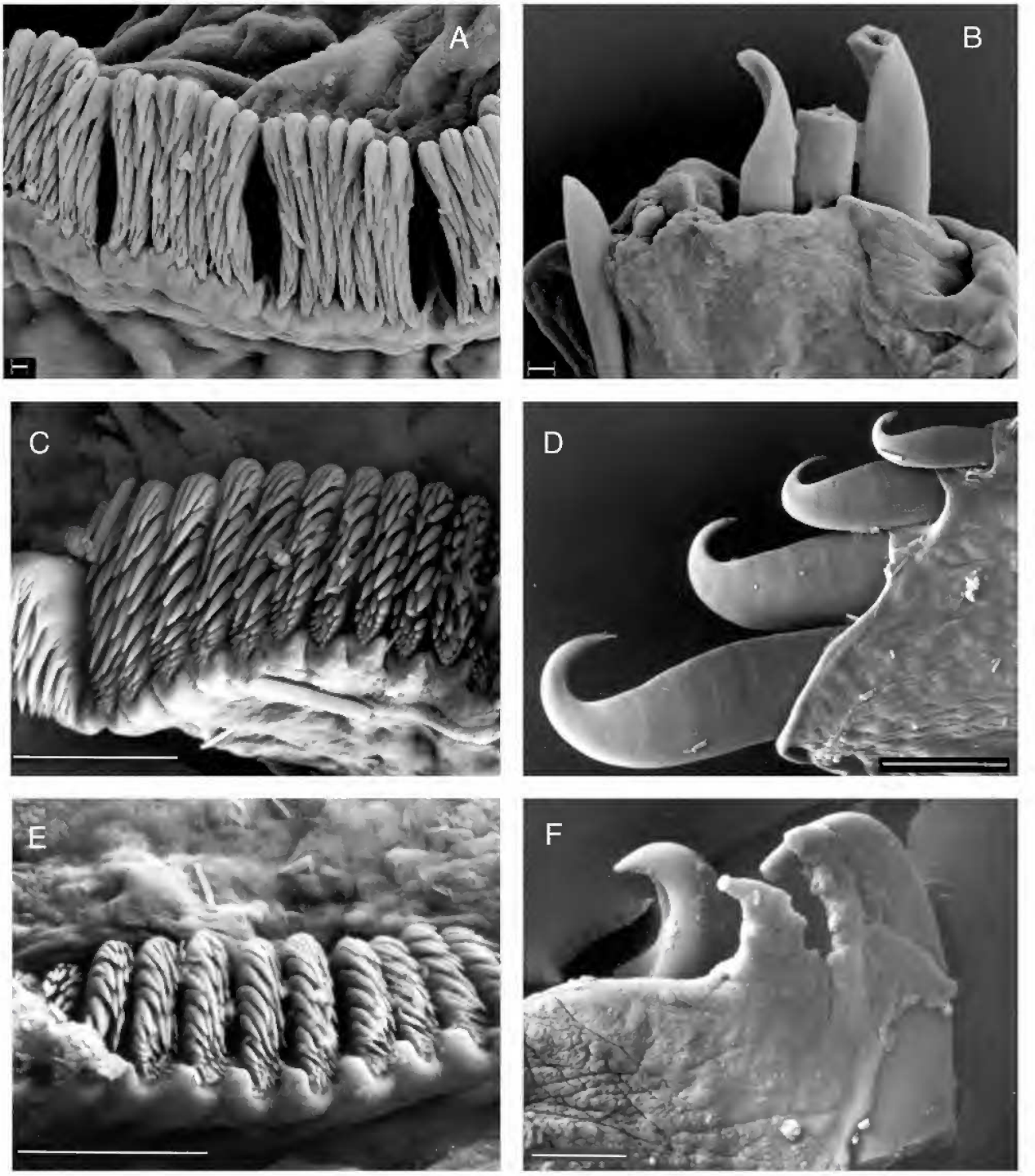

Figure 12. A, *Pectinaria antipoda* (Schmarda, 1861) neurochaetae from chaetiger 8, scale = 3 µm. B, *Pectinaria antipoda* (Schmarda, 1861), scaphal hooks, scale = 10 µm. C, *Pectinaria dodeka* n.sp. neurochaetae from chaetiger 8, scale = 20 µm. D, *Pectinaria dodeka* n.sp. scaphal hooks, scale = 50 µm. E, *Pectinaria kanabinos* n.sp. neurochaetae from chaetiger 8, scale = 20 µm. F, *Pectinaria kanabinos* n.sp. scaphal hooks, scale = 20 µm.

them to *P. dodeka* n.sp. as well as material he identified as *P. antipoda*. *Pectinaria dodeka* n.sp. can be distinguished from *P. brevispinis* by the number of cirri on the cephalic veil, 16–28 in *P. dodeka* and 25–30 on *P. brevispinis*, and the number and shape of scaphal hooks present.

Material identified as *P. antipoda* by Stephenson *et al.* (1974) from Moreton Bay was re-examined and consisted of both *P. antipoda* and *P. dodeka* n.sp.

Etymology. The specific name *dodeka* is from the Greek word for twelve and refers to the number of pairs of paleae present on the holotype.

Distribution. Gulf of Carpentaria, and the east Australian coast (Fig. 13), often associated with estuarine or sheltered waters.

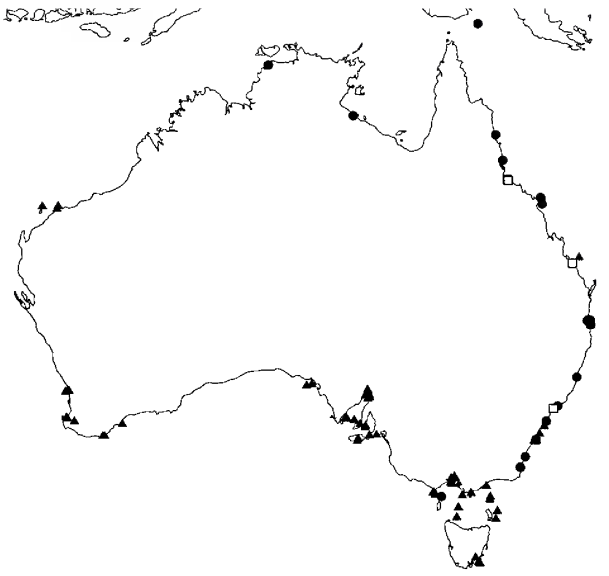

Figure 13. Distributional map for the Australian species of *Pectinaria*. ▲ *Pectinaria antipoda* Schmarda, (1861). ● *Pectinaria dodeka* n.sp. □ *Pectinaria kanabinos* n.sp.

Habitat. Collected from shallow waters to depths of 82 m, in soft sediments, sometimes associated with seagrass beds. Habitat data are lacking for many specimens.

Pectinaria kanabinos n.sp.

Figs. 11C–D, 12E–F, 13, 16A–B, 17A–C, Tables 4, 6

Type material. HOLOTYPE: 1, AM W25616*, 24.vi.1975, 14 mm long, 3 & 2 mm wide. PARATYPES: 1, AM W8534*, 24.vi.1975, 16 mm long, 4 & 2 mm wide; 1, AM W8535*, 24.vi.1975, 18 mm long, 3 & 2 mm wide; 1, BMNH 2001.67*, 26.xi.1975, 15 mm long, 4 & 2 mm wide.

Type locality. Queensland, Calliope River, north of Gladstone, 24°01'S 150°59'E, collected by P. Saenger.

Additional material examined. NEW SOUTH WALES: Lake Macquarie, Black Neds Bay, 32°59'S 151°38'E, 1, AM W7724*. QUEENSLAND: Halifax Bay, north of Townsville, 19°10'S 146°38'E, 5 m, i.1977, 1, AM W202174; 5 m, vii.1977, 2, AM W202186*; 5 m, vi.1977, 1, AM W202174; 2 m, i.1977, 1, AM W202176*. Material examined ranged from 10 to 24 mm long & 1 to 5 & 0.5 to 3 mm wide.

Description. Preserved specimen grey to pale cream in colour, body not robust. Rim of cephalic veil with 15 long cirri tapering evenly to fine thread-like tips. Cephalic veil completely free from operculum forming dorsal semi-circle surrounding numerous peristomial palps. Peristomial palps papillose, thick and numerous.

Raised opercular margin well developed and smooth. Operculum with 14 pairs of paleae, pale, clear, pointed gradually tapering to fine tips, curved dorsally, long (Fig. 16A).

First pair of tentacular cirri inserted on anterior edge of segment 2. Ventral ridge connecting second pair of tentacular cirri on segment 3 incised to form glandular lobes. Chaetiger 2 with anteroventral lobe large and broad; anterior margin of lobe smooth; posterodorsal lobe absent. Two pairs of well-developed, comb-like, stalked branchiae, consisting of loose, flat lamellae, lying flattened against the body.

Chaetigers 1 to 3 (segments 5 to 7) with notopodia and notochaetae only. Chaetigers 4 to 16 with both notopodia, neuropodia, notochaetae and neurochaetae. Notopodia and notochaetae of chaetigers 1 to 3 and 15 to 17 reduced in size compared to those on chaetigers 4 to 14. Chaetiger 17 with notopodia and notochaetae only. Notochaetae capillaries of varying length with one margin strongly pectinated (Figs. 11C–D, 17A). Neuropodia wedge-shaped, with rounded margins from midbody onwards, posteriorly the ventrolateral margins becoming hook-shaped. Neurochaetae with major teeth arranged in two vertical rows with about 12 teeth per row, although the basal teeth are small and difficult to count (Figs. 12E–F, 17B–C).

Posterior scaphe and abdomen distinctly separated. Posterior 5 segments fused to form a scaphe which is longer than broad, with crenulated margins. Scaphal hooks present, 5 pairs, fine, small, pale, colourless (Fig. 9F).

Glandular areas present as small pad-like areas on each segment present laterally along entire body length, and well-developed mid ventral glandular area between segments 2 and 3. Nephridial papillae not observed.

Variation. The number of cirri on the cephalic veil present varies from 10 to 16, 12–14 pairs of paleae and 4–6 pairs of scaphal hooks and does not appear to be related to animal size.

Remarks. *Pectinaria kanabinos* n.sp. can be distinguished from all other described species of *Pectinaria* by the following combination of characters: 10–16 cephalic cirri on the cephalic veil, 12 to 14 pairs of acute, needle-like paleae, and 4 to 6 pairs of fine scaphal hooks (see Table 4). The shape of the paleae is characteristic. Other species with fine paleae are *P. meredithi* Long, 1973, *P. papillosa* Caullery, 1944, *P. profunda* Caullery, 1944 and *P. californiensis* Hartman, 1941. All these species have a larger number of cirri on the cephalic veil, and more pairs of paleae and scaphal hooks than P. *kanabinos*, which for these reasons we describe as a new species.

Etymology. The specific name *kanabinos* is from the Greek word meaning long and slender, which describes the paleae of this species.

Distribution. Species described from two locations in Queensland, and one specimen collected from Lake Macquarie, New South Wales (Fig. 10).

Habitat. Sheltered bays or rivers, with muddy sediments, in shallow depths.

Petta Malmgren, 1866

Tables 5, 6

Petta Malmgren, 1866: 361.–Fauchald, 1977: 120.

Diagnosis. Rim of cephalic veil with smooth margins. Cephalic veil completely free from operculum, forming dorsal semi-circle around numerous peristomial palps. Raised opercular margin smooth. Chaetigers 1 to 3

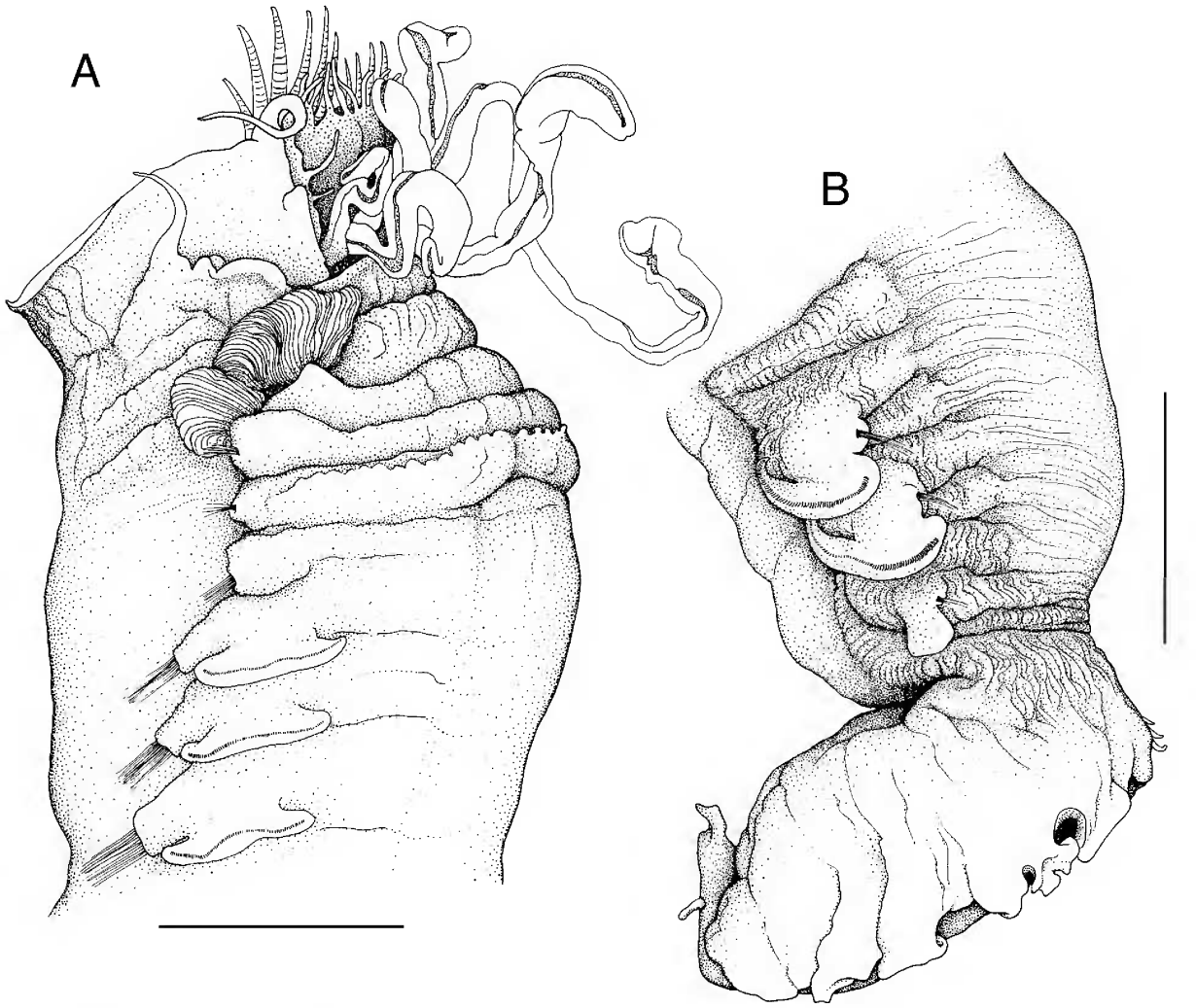

Figure 14. *Pectinaria dodeka* n.sp. Holotype (AM W25615). A, lateral view of anterior end, scale = 2 mm. B, lateral view of posterior end, scale = 1 mm.

(segments 5 to 7) with notopodia and notochaetae only, chaetigers 4 to 17 biramous with notopodia, neuropodia, notochaetae and neurochaetae, chaetiger 18 with notopodia and notochaetae only (18/14). Notochaetae all smooth capillaries. Neurochaetal uncini with major teeth arranged in one row. Posterior 5 segments fused forming flattened plate or scaphe, not distinctly separated from abdomen.

Type species. *Petta pusilla* Malmgren, 1866, by original designation.

Remarks. No Australian species have been recorded. The major diagnostic characters of the three species assigned to this genus are given in Table 5. Species are poorly differentiated from each other. Many characters that have been found to be useful in distinguishing species in other genera have not been described. All three species need to be redescribed. Two of them occur in deep water and only one species, *P. pusilla*, has been widely reported, although some of these records may need to be checked against material from the type locality. *Pectinaria tenuis* is known only from the type locality.

Table 5 (part). Major distinguishing characters of species of *Petta* (entries in parentheses are based on non-type material).

species	holotype length mm	holotype anterior width mm	nos. of pairs of paleae	shape of paleae	posterodorsal lobe (segment 2)	anteroventral lobe (chaetiger 2)
P. assimilis McIntosh, 1885	22	4.5 (3.5)	14	elongate, slender	*n.r.*	cirrate (7 or more pairs present)
P. pusilla Malmgren, 1866	15 (10–18)	3 (3–5)	11 (9–12)	flat, attenuated tip (short)	absent	absent (glandular)
P. tenuis Caullery, 1944	12	1.7	11	elongate, curved acute tip	*n.r.*	glandular

Discussion

Individuals belonging to the Pectinariidae are easy to recognise, but the systematics of this widely distributed family has been neglected. The confused identity of the common European species suggests that many species may have been misidentified or perhaps several species confused under one name. Certainly some of the species listed by Day & Hutchings (1979) from Australian waters do not occur there.

In this study, we have accepted all the previously recognised subgenera as full genera. The characters, that separate the five genera include: whether the cephalic veil is attached or free, the presence or absence of cirri on the cephalic veil and cephalic rim, the number of biramous thoracic chaetigers, the number of vertical rows of teeth on the neurochaetae, and the degree of separation of the scaphe from the abdomen (Table 6). We have also included for the genera represented in Australian waters, details of the capillary notochaetae which appears to be an additional generic character. Some generic characters overlap, and additional distinguishing characters are desirable. Although the number of uncinigerous segments is used as a generic character (see Table 6), we have also given the ratio of notopodia to neuropodia and differences between genera. However, not all species' descriptions include this information and in some cases we were able to determine

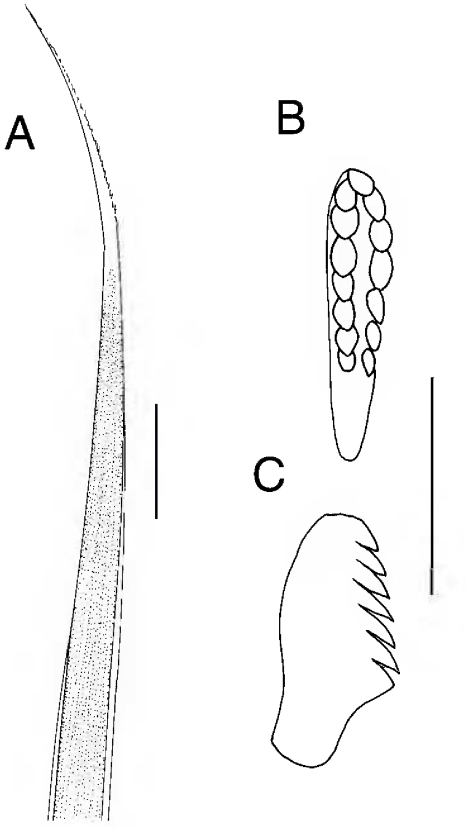

Figure 15. *Pectinaria dodeka* n.sp. Holotype (AM W25615). A, notochaeta from chaetiger 5. B, frontal view of neurochaeta from 6th uncinigerous segment. C, lateral view of neurochaeta from 6th uncinigerous segment. Scales = 100 μm.

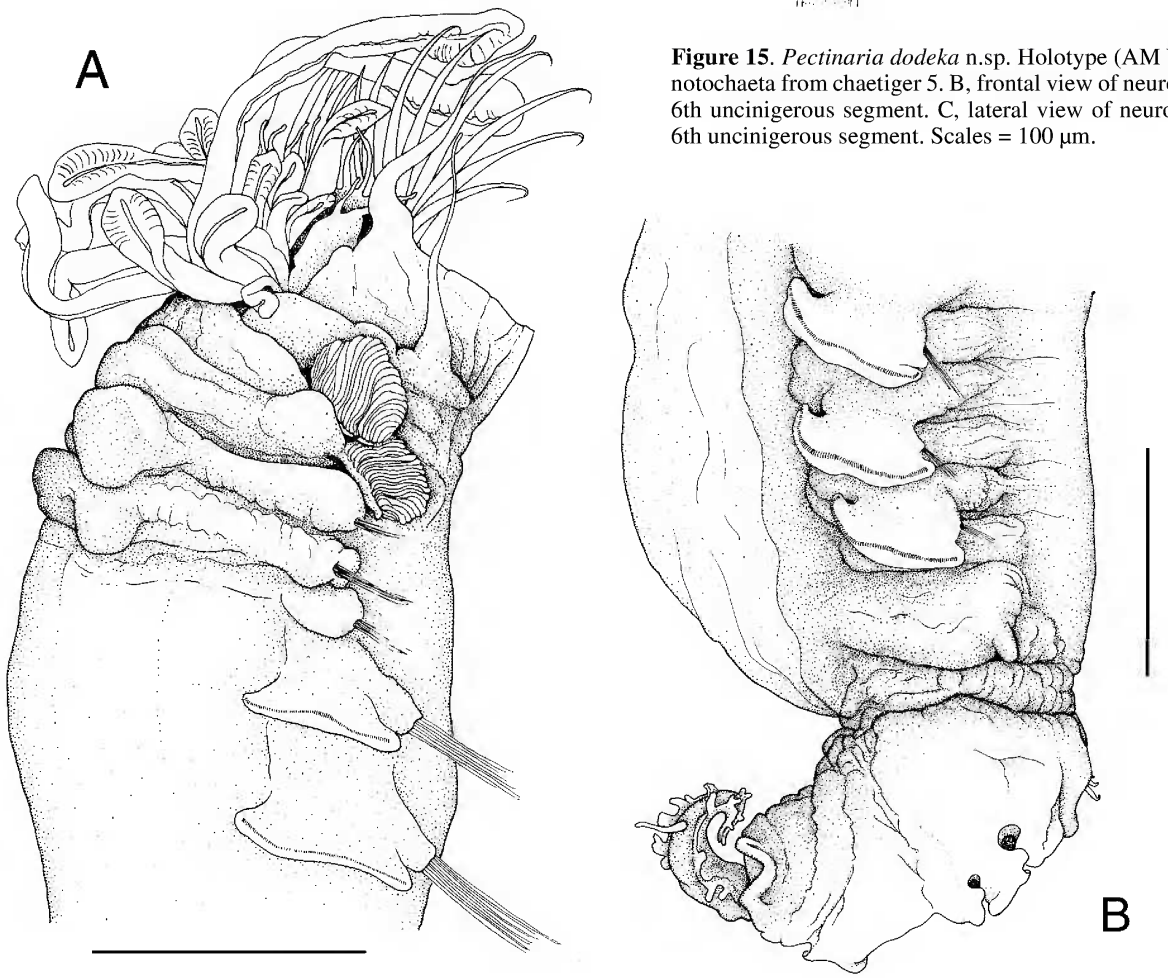

Figure 16. *Pectinaria kanabinos* n.sp. Paratype (AM W8535). A, lateral view of anterior end, scale = 2 mm. B, lateral view of posterior end, scale = 1 mm.

Table 5 (continued). Major distinguishing characters of species of *Petta*. (entries in parenthesis are based on non-type material).

species	chaetigers on which notopodia reduced	nos. of rows of teeth per uncinus	nos. of teeth within a row on uncinus	scaphal shape	scaphe: anal flap	scaphal hooks: nos. of pairs & type	tube, shape & construction	glandular areas	type locality	additional records and comments*
P. assimilis	*n.r.* (1–3)	*n.r.*	2	reduced (with 6 pairs of marginal triangular processes)	short, & conical with scale like process (not present)	*n.r.* (11, smooth, slightly falcate)	*n.r.* (fragile, covered with white *Globigerina* tests)	*n.r.*	between Prince Edward and Kerguelen Islands—2926 m	Recorded from Cape Horn, 1806–2013 m and Falkland Islands, 2452 m (Hartman, 1967).
P. pusilla	1–3, 18	*n.r.* (1)	*n.r.* (2)	oval, lobed margin (short, round, crenulated)	sub-filiform (cirriform)	*n.r.* (6–11)	slightly curved (made of sand grains and forams)	*n.r.* (strongly glandular)	Gullmarfjorden, Swedish west coast	(See below) [w]
P. tenuis	1–3	1	2–3	wide, crenulate edges	semi-circular with long narrow cirrus	8	*n.r.*	glandular	Indonesia (6°8'N 121°19'E)—275 m	Only known from the original record.

n.r. character not recorded.
* Only a selection of records are given based on the literature to indicate distribution of species, however distributions outside the region of the type locality require verification.
w [*pusilla*] Recorded from west coast of Sweden (Hessle, 1917); North Sea, English Channel, Atlantic Ocean, Azores, Irish Sea, Mediterranean Sea, Scandinavian coast, Arctic Sea (Fauvel, 1927); Faeroes, Kattegat, Scandinavia (Holthe, 1986).

Figure 17. *Pectinaria kanabinos* n.sp. Holotype (AM W25616). A, two types of notochaetae from chaetiger 5. B, frontal view of neurochaeta from 6th uncinigerous segment. C, lateral view of neurochaeta from 6th uncinigerous segment. Scales = 100 µm.

this ratio from figures supplied. Some discrepancies with the generic diagnosis resulted, so the validity of the character needs further testing. Future studies should carefully document this ratio. Certainly some species have reduced posterior notopodia that may easily be overlooked especially in small individuals, resulting in an inaccurate ratio being given. Future studies need to clarify these generic characters, to avoid characters such as one of those in *Lagis*, where the cephalic veil is only partially fused, which may be open to interpretation.

Specific characters for the family include the number and shape of paleae, the number of cirri on the cephalic veil and the number of pairs of scaphal hooks. In *Pectinaria*, additional specific characters are the anteroventral lobe of chaetiger 2, which may possess lobes and the number of cirri on the dorsal raised opercular margin. These characters need to be well illustrated.

Many species are poorly known. Fifty three species of Pectinariidae have been described, of which 23 are known only from the type description. Many of these species need to be re-examined for diagnostic characters (see Tables 1–5). Features such as the shape of the scaphal hooks and paleae have often not been illustrated or compared with those of previously described species. The actual size of the paleae may not be diagnostic because they may be worn by digging. Damaged paleae were commonly seen and presumably can be replaced. Other factors that need to be

Table 6. Characters distinguishing genera of Pectinariidae.

genus	cephalic veil	opercular rim	chaetigers biramous (ratio of noto-neuropodia)	type of notochaetae	nos. of vertical rows of teeth on uncini	scaphe
Amphictene Savigny	free, cirrate	raised, cirrate	4–16 (17/13)	smooth & finely pectinated margins	2	distinctly separated
Cistenides Malmgren	free, cirrate	raised, smooth	4–16 (17/13)	?	1	distinctly separated
Lagis Malmgren	partially fused to bases of tentacular cirri, cirrate	raised, smooth	4–15 (16/12)	smooth	2 or 2+	distinctly separated
Pectinaria Savigny	free, cirrate	raised, smooth	4–17 (17/14)	smooth & cirrate	2	distinctly separated
Petta Malmgren	free, smooth	raised, smooth	4–17 (18/14)	smooth	1	not distinctly separated

considered in future studies are characters exhibiting variation in numbers with size and presumably age. These include the number of paleae and the number of cirri on the cephalic veil. Detailed morphometric studies should be carried out to ascertain the variation of these character within a species.

The position of nephridial papillae differs between *Amphictene favona* and *P. antipoda* but whether this represents a consistent generic difference is unclear. In all the other species that we examined, the position of these structures could not be determined and has rarely been reported in the literature. Further work is needed to clarify this.

Of the five described genera, four occur worldwide and one, *Cistenides*, has a restricted distribution. Three genera, *Cistenides, Petta* and *Lagis*, do not occur in Australian waters. The diagnostic characters of the species recorded in the Tables 1–5 are based mainly on the literature. We have moved species that obviously belong in another genus, but other species may also need to be reassigned once they are re-examined. Variation in characters described from non-type material has been included in brackets in these tables, and some additional records of species may prove to be misidentifications.

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